RCRA FACILITY INVESTIGATION WORK PLAN ADDENDUM #2

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DELPHI ENERGY & CHASSIS SYSTEMS
PLANT 400
1300 NORTH DORT HIGHWAY
FLINT, MICHIGAN

US EPA ID # MID 005 356 647

by

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File No.: 49017-027
February 2004

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1 INTRODUCTION

This work plan is an addendum to the RCRA Facility Investigation (RFI) Work Plan dated March 2003 and Work Plan Addendum #1 dated 28 April 2003, both prepared by Haley & Aldrich for Delphi Corporation. This work plan addendum defines the scope of work for Field Event #3 for the RCRA Facility Investigation (RFI) being conducted at the Delphi Flint-East Plant 400 site (Figures 1 and 2).

The scope of work has been developed based on an evaluation of data collected during the RFI Field Event #1 and Field Event #2. Data collected during previous Field Events were screened against conservative human health risk-based screening criteria as described in the *Report on RCRA Facility Investigation, Investigation Data Report No. 2* dated November 26, 2003 (Data Report No. 2).

Activities described in this addendum, including field work, surveying, quality assurance, quality control, and laboratory analysis, will be performed in accordance with the Field Sampling Plan (FSP) included with the RFI Work Plan (Haley & Aldrich, March 2003) and Appendix A of this addendum.

2 FIELD EVENT #3

Based on the data evaluation provided in the Field Event #2 Data Report, field activities were identified to collect additional information required to complete the supporting documentation for the Environmental Indicators and to complete the RFI risk assessment. These activities include;

- Collect supplemental hydrologic data to refine and confirm the site hydrogeologic conceptual model
- Further characterize groundwater
- Perform location surveying
- Interim measures pilot study

The primary focus of the field event is to characterize groundwater and establish a monitoring program to meet the CA750 goals and to collect data necessary to complete the RFI consistent with the Voluntary Corrective Action Agreement. Unless otherwise specified below, groundwater samples from monitoring wells will be collected using low-flow sampling methods as described in the March 2003 *Field Sampling Plan* (FSP).

With the exception of Task 5 and Task 8, further soil sample quality sampling and analysis is not required. However, additional soil sampling may be undertaken if field conditions indicate the presence of contamination. This soil sampling, if undertaken, will follow the field procedures described in the RFI Work Plan. The work scope described herein includes screening soil samples for the potential presence of DNAPL as discussed in specific tasks below and will follow the updated soil classification methods attached in Appendix A.

The target saturated zone for monitoring well installations are designated as Zone 1 or Zone 2 as defined in Data Report No. 2 (Haley & Aldrich, November 2003).

Unless otherwise specified, monitoring wells will be constructed as described in the FSP (Haley & Aldrich, March 2003). Unless specifically stated in the task described below, the drilling to install monitoring wells will include casing off Zone 1 (when aquitard layer is present) prior to drilling into Zone 2 to prevent the potential vertical migration of contaminants during the drilling process.

The proposed locations shown on the attached figures are approximate. The actual location of the sampling will be adjusted as necessary based on site features such as utilities or surface obstructions. Locations may also be adjusted to bias the sampling locations to areas of potential contamination or likely migration pathways.

Quality control samples (field duplicates, trip blanks, equipment blanks, MS/MSD samples) for soil and groundwater will be collected as described in the Quality Assurance Program Plan (QAPP, March 2003).

Details of the Field Event #3 activities are summarized in Table I and described below.

2.1 Field Event #3 Tasks

The focus of this field event is site-wide groundwater (AOI-48). However, certain areas of groundwater contamination have been related to other AOIs as presented in Data Report No. 2 (Haley & Aldrich, November 2003). Based on evaluation of RFI data, several areas were identified to refine of the geometry of contaminated groundwater or to confirm the vertical extent of contamination. Areas that will be investigated during FE #3 include:

AOI-8 Former Hard Chrome Plating Line
AOI-11 Executive Garage
AOI-13 Gridley Area
AOI-22 Crane Bay
AOI-26 Container Storage Area
AOI-48 Site Wide Groundwater
AOI-50 Crane Bay

The scope of Field Event #3 field activities are discussed below.

Task 1. Supplemental Site-wide Monitoring Well and Boring Installation

Based on the data from monthly groundwater elevation monitoring, two piezometers will be installed to refine the interpretation of groundwater flow direction of Zone 2 in the southern portion of the Site. The two new piezometers (PZ-4607D and PZ-4119D) will be installed at the approximate locations shown on Figure 3.

The boring for each of these piezometers will be cased into the first clay layer and then advanced to a depth sufficient to identify the clay layer beneath Zone 2. Continuous soil samples will be collected to record the soil type. The piezometers will be installed as described in the FSP. These piezometers will not be sampled for soil or groundwater.

In addition to the installation of two piezometers, four borings (VHC-4008 through VHC-4011) will be advanced at the approximate locations shown in Figure 3. These borings were selected to collect geologic information on the geometry of Zone 1, Zone

2 and the clay layer beneath each. Upon completion of the boring, they will be sealed/abandoned as specified in the FSP.

Based on review of groundwater measurements, original installation logs and geochemical data, two pre-RFI monitoring wells, MW-4115 and MW-4613 will be abandoned and replaced. These wells will be abandoned as described in the FSP. Adjacent to each of these monitoring wells, new monitoring wells will be installed consistent with the methods described in the FSP. Monitoring well MW-4613R (replacement well for MW-4613) will be double-cased into the clay layer beneath Zone 1 (if present) and screened at the top of Zone 2. MW-4115R (replacement well for MW-4115) will be installed in the first saturated sand unit encountered at this location.

In addition, monitoring wells noted during sampling or groundwater elevation monitoring that require maintenance or repair will be repaired as necessary.

Task 2. Subsurface Utilities and Storm Water Sewer Assessment

Based on available data, subsurface utilities and storm water sewers may influence shallow groundwater flow and contaminant transport in areas proximal to these sewers. The primary areas of concern are on the north property boundary where dense non-aqueous phase liquid (DNAPL) was detected (Figure 2) and the southeast quadrant of the site where invert elevations of storm sewers appear to intersect shallow groundwater.

To further evaluate the potential influence of subsurface utilities and storm water sewers in both of these areas, a field mapping and surveying of the storm water sewer manholes or access rims will be undertaken during Field Event #3. Field mapping of process waste and storm sewer lines will be undertaken in the areas shown in Figure 4. Each access point (manhole, surface drain or clean out) will be opened and the piping will be observed and extrapolated to other access and drain locations.

The depth of each connecting pipe and bottom of the manhole will be measured from the rim of the access point. Similarly, the depth to liquid will be measured and flow direction, if discernable, will be noted. If necessary, die tracing will be used to confirm connections between locations. Each critical access point will be surveyed (Task 13) to obtain lateral and vertical controls to determine the pipe and flow elevation.

Based on the results of this task, critical points along the sewer network will be included in the monthly groundwater elevation monitoring described in Task 3 below.

Task 3. Groundwater Elevation Measurements

As part of the Work Plan Addendum #1 (April 2003), groundwater elevations were measured from April 2003 through December 2003. Monthly groundwater elevations will continue to be collected from January 2004 through June 2004. The monitoring wells, sewers (to be determined under Task 2), peizometers, and surface water gauging stations to be monitored during this task are included in Table I. These data will be used to evaluate seasonal groundwater changes, saturated thickness, flow direction and monitor for free product.

Task 4. Characterization of Chromium in Groundwater (AOI-08 Former Hard Chrome Plating Line)

Based on the site wide monitoring well network, an extent of hexavalent chromium in groundwater at this AOI has been established. However, the geometry of the contaminated groundwater in this area is not well understood. Accordingly further characterization will be undertaken. Groundwater grab samples will be collected and submitted to the contract laboratory for total and hexavalent chromium analysis to establish the geometry of chromium exceeding applicable screening criteria.

Groundwater grab samples will be obtained using direct push technology at 8 locations (GP-4201 – GP-4208) as shown on Figure 5. These groundwater grab samples will be field analyzed for pH and submitted to the contract laboratory for total and hexavalent chromium with a 24-hour turn around analysis. In addition, concurrent with the groundwater grab sample collection, a groundwater sample will be obtained from MW-4637S and analyzed as described above.

At each boring location, continuous soil samples will be collected for visual classification. The soil boring will be continued to the clay layer beneath Zone 1. The groundwater sample will be obtained from this terminal depth, anticipated to be approximately 15 ft below ground surface.

The results from the groundwater grab samples and groundwater collected from MW-4637S will be used to determine if additional locations are required to define the geometry of the chromium affected groundwater. Additional groundwater grab samples will be obtained as necessary to define the area of affected groundwater.

Upon receipt of the laboratory analysis results, up to five monitoring wells may be installed. Up to four of these five monitoring wells are anticipated to be installed with a five ft. screen extending approximately 0.5 ft. into the clay layer beneath Zone 1. Based on MW-4640S, the terminal depths of these four shallow wells are anticipated to

be approximately 15 feet below ground surface. The location of these four wells will be selected based on the results of the above field analysis and based on the following;

- One well to provide an upgradient control,
- One well to provide additional characterization within the area of affected groundwater,
- One well to provide lateral extent or cross-gradient extent (anticipated to be approximately at the location of previous sample location B-4082), and
- One well to provide down gradient monitoring of the affected groundwater.

It is anticipated that MW-4637S will provide an additional cross gradient control location of the affected groundwater. An additional monitoring well will be installed if MW-4637S does not provide adequate coverage to refine the geometry of the affected groundwater.

An additional monitoring well (MW-4640D) will be installed with double casing into the clay layer, down gradient of the affected area to evaluate groundwater quality in Zone 2 with respect to chromium. This well will be installed with a 10 ft. screen extending down from the top of Zone 2. The approximate location of this monitoring well is shown in Figure 5.

Upon development of the new monitoring wells, groundwater samples will be collected from the monitoring wells indicated in Table I. Groundwater samples will be collected as described in the FSP. These groundwater samples will be submitted to the contract laboratory for TAL Metals and hexavalent chromium analysis as discussed under Task 12. QA/QC samples will be collected as defined in the QAPP.

Task 5. <u>BTEX and PAHs in Groundwater UST #4039 (AOI-11 – Executive Garage)</u>

BTEX, PAHs and lead were detected in groundwater samples from monitoring wells believed to be down gradient and in proximity of UST #4039. Tank #4039, which was reported to be on the upgradient edge of the restricted area, was closed in-place by filling with sand in 1978. The exact location of this tank is unknown, however, it is possible that this tank is the source of BTEX or PAHs detected in groundwater.

A GPR survey will be conducted in this area to attempt to identify the tank location. If the GPR survey identifies a probable tank, a direct-push boring (B-4111) will be installed upgradient of the tank location. Up to two soil samples and one groundwater sample from Zone 1 will be collected at this location. These data will be used to evaluate whether the tank may be the potential source of the BTEX and PAHs in groundwater. The soil and groundwater samples will be submitted to the contact

laboratory for TCL VOCs, TCL SVOCs, and lead analysis. If the GPR survey does not identify the probable tank location, the sampling above will not be undertaken.

To further evaluate the elevated PAHs and lead detected in MW-4005, a monitoring well (MW-4010) will be installed in Zone 1 at the approximate location shown on Figure 6. Upon development, this monitoring well and MW-4005 will be sampled as described in the FSP. The samples will be submitted to the contract laboratory for TCL VOCs, TCL SVOCs and lead analysis.

In addition to the monitoring well above, a monitoring well (MW-4009D) will be installed in Zone 2 to evaluate groundwater quality (Figure 6). This monitoring well will be double cased and screened in the top 10 feet of Zone 2. After development, this monitoring well will be sampled and the groundwater sample will be submitted to the contract laboratory for TCL VOCs, TCL SVOCs and lead analysis.

Additional monitoring wells in this area will be sampled as described under Task 12.

Task 6. Extent of LNAPL (AOI-13 – Gridley Area)

An interim pilot test for product recovery at AOI-13 is discussed under Task 14. However, during Field Event #2 monitoring well MW-4418 was installed to provide delineation of the extent of free product. During subsequent monitoring, free product was detected in this well.

Two additional monitoring wells (MW-4419 and MW-4420) will be installed to delineate the extent of free product in this area. The monitoring wells will be installed in Zone 1 at the approximate locations shown on Figure 7. The borings will be extended to a depth necessary to identify the clay layer beneath Zone 1 and the wells will be installed such that the screened interval will straddle the seasonal fluctuations of the water table.

The developed wells will be sampled as identified under Task 12. Groundwater samples will be submitted to the contract laboratory for TCL VOC and TCL SVOC analysis. If product is detected in either of these monitoring wells prior to groundwater sampling, no groundwater sample will be obtained but an additional monitoring well or wells will be installed as necessary to complete the delineation of the extent of free product.

Task 7. Extent of LNAPL (AOI-22 – Chip Collection Area)

LNAPL has been detected in MW-4645S in the Chip Collection Area. Three additional monitoring wells (MW-4649S, MW-4650S and MW-4651S) will be installed in Zone 1 to delineate the extent of free product. The monitoring wells will be installed at the approximate locations shown on Figure 8. The borings will be extended to a depth necessary to identify the clay layer beneath Zone 1 and the wells will be installed such that the screened interval will straddle the seasonal fluctuations of the water table.

The monitoring wells in this area will be monitored under Task 3. If product is detected in a monitoring well then an additional monitoring well or wells will be installed as necessary to complete the delineation of the extent of free product.

Task 8. AOI-26 – Container Storage Area

To confirm the soil conditions near the former Tank #4011, soil samples will be collected at the approximate location (B-42612) shown on Figure 9. Soil samples will be collected as described in the FSP and submitted to the contact laboratory for TCL VOC and TCL SVOC.

In addition, monitoring wells in this area will be sampled as described under Task 12. Additional activities will be undertaken in this area as described in the Post Closure Care Plan dated 15 February 2004. Data collected as part of the Post Closure Care Plan may also be used to evaluate this area during the RFI.

Task 9. Carbon Tetrachloride and Trichloroethene (TCE) in Groundwater (AOI-48)

Carbon tetrachloride was detected in groundwater samples from monitoring wells MW-4642S and MW-4643S above groundwater contact screening. In addition trichloroethene (TCE), cis-1, 2-dichloroethene, vinyl chloride and chloroform (a primary degradation product of carbon tetrachloride) were detected above drinking water criteria.

To further refine the understanding of geometry of the chlorinated compounds in groundwater, groundwater grab samples will be collected at the approximate locations (GP-4231 – GP-4245) shown on Figure 10.

At each boring location, continuous soil samples will be collected for visual classification, field PID head space screening and chlorinated NAPL field screening. The soil boring will be continued to the clay layer beneath Zone 1. The groundwater sample will be obtained from this terminal depth, anticipated to be approximately 15 ft

below the ground surface. The groundwater grab samples from each location will be analyzed by the contract laboratory for TCL VOC analysis with 24-hour turn around analysis.

Based on the results of the laboratory analysis, additional groundwater grab samples will be collected as necessary to delineate the extent of chlorinated compounds in groundwater and determine appropriate monitoring well placement.

As indicated above, soil samples from each location will be field screened using PID head space measurements. If head space readings are detected above background then the soil sample from this interval will also be field screened for the presence of chlorinated NAPL by USEPA approved Sudan IV test kit or FLUTe technique.

Based on the groundwater grab sample results, up to five additional monitoring wells may be installed. Four of these monitoring wells will be installed in Zone 1 with a five ft. screen extending approximately 0.5 ft. into the clay layer.

The location of these four wells will be selected based on the results of the above field screening and based on the following goals:

- One well to provide an upgradient control,
- one well to supplement lateral or cross-gradient extent, and
- Two well to provide down gradient monitoring of the affected groundwater.

It is noted that MW-4117 and MW-4119 already appear to provide confirmation of the lateral extent of affected groundwater.

A fifth monitoring well may be installed in Zone 2 at the down gradient edge of the affected groundwater. Due to remaining uncertainty of the flow direction of Zone 2 in this portion of the site, this well installation may occur after completion of Task 1, Task 3 and Task 12. It is possible that existing monitoring wells are appropriately located to provide adequate data. If so, no additional monitoring wells will be installed for vertical delineation of groundwater in this area.

Upon development of the new monitoring wells, these new monitoring wells and existing monitoring wells, as listed in Table I, will be sampled as described in the FSP. Samples will be submitted to the contract laboratory for TCL VOC analysis.

Task 10. TCE in Groundwater Northwest Property (AOI-48)

Four tasks are identified for Field Event #3 to characterize the groundwater in the northwest portion of the Site. These four tasks are;

a. Delineate DNAPL along northern property boundary
b. Delineate TCE in shallow groundwater north of Davison Road
c. Install supplemental monitoring locations west of N. Dort Highway
d. Perform an aquifer test

Each task is described below.

Delineate DNAPL

Soil samples will be collected and field screened for the presence of chlorinated DNAPL using Direct Push sampling methods. The field testing and sample collection will start at the five approximate locations (GP-4261 – GP-4265) shown on Figure 11 and be expanded as necessary to delineate the lateral and vertical extent of the DNAPL. Samples will be collected in two foot intervals to approximately 18 feet below ground surface and field screened for the presence of chlorinated volatile compounds using one or more of the following methods:

A) PID Headspace Field Screening
B) Sudan 4 Shake Test – This is a visual test in which dye is absorbed in free-phase product.
C) Chlorinated NAPL Test Fabric – This method allows core samples to be drawn and then enclosed with the color reactive hydrophobic material. NAPL fluids in contact with the cover are wicked into the cover and produce a visible stain indicating the presence of chlorinated product.

If soil samples tested do not indicated the presence of NAPL from the first set of locations, one additional set of samples will be collected between the first set to tighten the horizontal sampling interval. Each borehole advanced will be abandoned as prescribed in the FSP.

If it is required to step out from this initial set of samples, it may be necessary to drill on and through Davison Road. All requirements of the City of Flint and Michigan DOT will be followed and permits obtained before drilling within the road way. Surface soil samples (0 – 2 feet) will be collected from the five initial locations shown on Figure 11 and submitted to the laboratory for TCL VOC analysis. These samples will be collected to evaluate potential direct contact exposure pathway. In addition,

approximately 10% of the soil samples field screened will be submitted to the contract laboratory for confirmation TCL VOC analysis.

Delineate TCE North of Davison Road

To determine the extent of dissolved TCE in shallow groundwater north of Davison Road, a phased investigation using direct push technology followed by monitoring well installation will be used. A portion of this sampling program will require access permission from commercial property owners north of Davison Road.

The first phase includes six direct push sampling locations (GP-4301 – GP-4306) in the right-of-way of Davison Road and on the commercial properties. The approximate locations are shown on Figure 11. This initial sampling will be performed to obtain continuous soil samples to classify soil and to obtain groundwater samples from Zone 1. If groundwater cannot be obtained, soil samples from Zone 1 will be collected. Groundwater (or surrogate soil) samples will be submitted to the contract laboratory and analyzed for TCL VOCs with 72-hour turn around.

Based on the results of these samples, additional direct push samples will be collected as necessary to identify the extent of TCE in groundwater. If field PID screening or observations indicate the potential presence of free product, DNAPL field identification methods, as described above, will be used to determine the presence of chlorinated DNAPL.

Based on the results from tasks above, additional monitoring well(s) will be installed as necessary to confirm the direct push samples and to allow for permanent groundwater sampling points. It is anticipated that two new monitoring wells will be installed. The location of these monitoring wells will be determined based on the results of the direct push sample analysis results discussed above. It is anticipated that the monitoring wells will only be installed in Zone 1 and will require right-of-way permits from the City of Flint or property owner permission.

Upon development of the new monitoring wells, these new monitoring wells will be sampled as described in the FSP. Samples will be submitted to the contract laboratory for TCL VOC analysis (Table I).

Supplemental Monitoring Well Installation

An additional monitoring well (MW-4630M2) will be installed as part of the MW-4630 triplet series. This well will be installed with a 5 foot screen with the top of the screen approximately 1 foot below the bottom of MW-4630M. Two additional clusters (MW-

4646M/D and MW-4647M/D) will be installed approximately 75 ft north and south of MW-4630 series (Figure 11). These clusters will consist of two monitoring wells screened in Zone 2.

To confirm the vertical extent of constituents in the northwest, a monitoring well (MW-4648) will be installed approximately as shown in Figure 11. This well will be double cased into the clay layer beneath Zone 2 and screened in the first low permeability unit encountered beneath the clay layer. It is possible, although unlikely, that bedrock may be encountered as the next hydrostratigraphic unit. In this case, bedrock wells will be installed in the upper 10 feet of the bedrock. Monitoring wells will be installed as described in the FSP and Appendix A.

Upon installation and development of the new monitoring wells, these and existing monitoring wells will be sampled as shown in Table I. Sampling will be sampled as described in the FSP. Samples will be submitted to the contract laboratory for TCL VOC analysis.

Aquifer Test

An aquifer test will be conducted along the northwest property boundary to collect hydrogeologic information necessary to complete the RFI. A new monitoring well RW-4604 will be installed for use as the pumping well during this test. This monitoring well will be constructed with 4-inch diameter casing. The approximate location of RW-4604D is shown on Figure 11.

This location has been selected for the aquifer test for the following reasons:

- This area is located along the axis of the VOC plume at the western property boundary of the facility – an optimal location for the installation of a system to control offsite migration of the VOC plume.

- This area is located in an area where hydrogeologic conditions are representative of the plume area – the confining unit separating the shallow and deeper aquifers is absent, and hydraulic conductivities from slug test data appear to be representative of the aquifer as a whole.

- This area is far enough from the area of DNAPL occurrence that mobilization of DNAPL as a result of aquifer response to the test is unlikely.

- The position of the well in relation to surrounding wells and spacing of the well network are optimal for monitoring the aquifer response.

- The basal clay comprising the lower boundary of the aquifer has been encountered by MW-4604D, and the sand interval comprising the aquifer is understood.

Wells selected as monitoring points during the aquifer test include MW-4604, MW-4629D (150 ft distant from RW-4604), MW-4627D (188 ft), MW-4623D (275 ft), MW-4628D (286 ft), MW-4603 (370 ft), and MW-4605 (400 ft). If at anytime during the aquifer test, the water levels in either MW-4623D or MW-4605D are affected more than 0.5 feet from the baseline, the aquifer test will be halted to limit the potential to mobilize DNAPL present approximately 500 ft upgradient from the pumping well. It is noted that the DNAPL delineation will be completed prior to the start of the aquifer test.

Water levels will be monitored using dataloggers placed in the observation wells. Water levels will be monitored for a period of one week prior to initiation of the aquifer testing program. These data will be used to determine natural background fluctuations in water levels, estimate barometric efficiencies and to identify any local influences on water levels.

It is anticipated that a constant rate aquifer test will be conducted between 24 to 48 hours, depending on the degree of drawdown in wells. Recovery of the aquifer will be monitored in the pumping well and selected monitoring wells following cessation of pumping. Water levels will be monitored during the recovery period until the water level in the pumping well has experienced at least 90% recovery.

Groundwater produced during the aquifer test will be discharged to the Plant process-water stream and treated at the Wastewater Treatment Plant. Treated water will then be released to the sanitary sewer as part of the Plant process water. Existing permit limits should not be exceeded by addition of produced groundwater to the wastewater stream. Permission will be obtained from the City of Flint to add produced water to the Plant process stream.

Task 11. Characterization of Vinyl Chloride in Groundwater and Benzo(a)pyrene in Shallow Soil (AOI-50 Crane Bay)

Vinyl chloride was detected in a groundwater sample from MW-4634S above groundwater contact screening criteria. Chlorinated compounds, TCE and degradation products, were detected in LNAPL samples collected from MW-4621S.

Four direct push groundwater grab samples will be obtained at the approximate locations (B-4501 – B-4504) shown on Figure 12. Continuous soil samples will be collected for visual classification but no samples, except surface soil samples as discussed below, are anticipated to be submitted for chemical analysis. Each boring will be installed to the clay layer beneath Zone 1. A groundwater grab sample will be collected from this terminal depth. These groundwater samples will be submitted to the contract laboratory for TCL VOC analysis with appropriate QA/QC samples as described in the QAPP.

Based on the results of the groundwater grab samples analysis above, additional groundwater grab samples may be obtained to provide adequate information for the placement of permanent monitoring wells. Up to two monitoring wells may be installed in Zone 1 to provide permanent sampling points. The location of the monitoring wells will be determined based on the results of the above sample analysis and inferred groundwater flow direction.

Benzo(a)pyrene was detected in shallow soil (1-3 ft bgs) above the Industrial Direct Contact screening criteria. To further delineate the extent of the benzo(a)pyrene, shallow soil samples will be collected from the four approximate locations shown on Figure 12. Shallow soil samples, 0 to 2 feet below the concrete cover, will be collected and submitted to the contract laboratory for PAH analysis. Based on the results of the soil sample analysis, additional samples may be obtained to provide refined delineation of the benzo(a)pyrene.

Task 12. Site-wide Groundwater Sampling

Groundwater samples will be obtained from monitoring wells as described in Table I. These samples are designed to provide monitoring information to demonstrate stability of the constituents in groundwater and include groundwater sampling described under other tasks. An additional groundwater sampling of site wide monitoring wells will be performed in May 2004 as described in Table I. These results to be used in the Groundwater EI report due to the U.S. EPA by 30 September 2004.

Groundwater samples will be collected as described in the FSP.

Task 13. Surveying

A survey to determine elevation and the horizontal location of each new monitoring well installed during the above tasks will be performed as described in the RFI Work Plan and FSP. In addition, underground utility access locations identified during Task

2 will be surveyed. Each boring location installed in during Task 9 and Task 10 will also be surveyed to establish ground surface elevations.

Task 14. Free Product Recovery and Evaluation at AOI-13 Gridley Area

LNAPL has been detected in monitoring wells dating back to February 1992. Based on field activities performed during May 2003, the volume of LNAPL beneath the Gridley area was estimated to be over 15,000 gallons. Ground water flow is inferred toward the northeast.

During 1992 through 1996, recovery wells and total fluids recovery pumps were installed and operated at the site. The system is not operational. During operation, the recovered LNAPL/water mixture was discharged to plant's wastewater treatment plant where oil could be skimmed off of the surface of the clarifier tanks and stored in a holding tank. However, the volume of oil recovered was not monitored to evaluate the removal efficiency of the system.

An LNAPL product recovery system will be tested and evaluated for passive recovery of LNAPL from several wells. The system to be tested is portable, but can be converted to a long-term system if it is determined to be effective for LNAPL recovery.

The activities described below will provide information on the effectiveness of this passive LNAPL recovery system. Data collected during performance of these activities will be used to evaluate the systems ability to recover LNAPL and to develop a long term strategy for LNAPL recovery within the AOI.

The scope of work includes:

- Removal/recovery of free product from selected wells where product thickness has indicated the potential for significant product removal;
- Evaluation of effectiveness of LNAPL recovery at several locations within the identified extent of LNAPL;
- Evaluation of LNAPL recovery rate over a prolonged (3-day) recovery event;
- Evaluation of LNAPL recovery rate variability from separate calendar periods,
- Determination of well yield from separate recovery events;
- Assess the need for additional containment that may be necessary to minimize down-gradient migration, and
- Observation of communication between monitoring wells during recovery activities.

A portable LNAPL recovery system will be used at monitoring wells MW-4401, MW-4408, MW-4410, MW-4413, and MW-4415. As previously stated, during the recovery activities, data will be collected to evaluate the potential for LNAPL recovery and evaluate the recovery pump effectiveness.

Prior to the start of product recovery, baseline groundwater elevations and LNAPL thickness will be collected in all accessible groundwater monitoring and recovery wells. The elevation and thickness will be measured to the nearest 0.01 foot using an electronic oil-water interface tape. The measurements will provide additional baseline measurements for future data assessment.

At each well, the recovery system will be operated continuously for approximately 72 hours. Each well will be evaluated independently of the other wells. Recovered product will be transferred into an appropriate container. During system operation, the quantity of product recovered will be monitored.

Upon completion of 72 hours of operation, a second set of groundwater and LNAPL thickness measurements will be obtained from surrounding monitoring and recovery wells. The system will be shut-off and all equipment in the well will be removed and placed in a containment device for decontamination and reuse at the next well. The LNAPL thickness will be monitored for six hours to evaluate LNAPL recovery at that well. Based on previous investigation activities, complete recovery is anticipated to occur within 6 hours of system shut down. LNAPL thickness will be monitored at thirty minute intervals for two hours, then hourly for the next four hours. Data collected during this portion of product recovery will be used to evaluate the LNAPL recovery rate for the well as well as to evaluate potential communication between wells.

The recovery system will be moved to the next well and the process will be repeated until all wells are evaluated. If the results obtained during the first round of recovery indicate the recovery pumps are feasible and LNAPL may be recoverable, additional data gathering will be collected to support long term LNAPL recovery design efforts. Therefore, the recovery activities will be repeated at each well during the following two months (for a total of up to three recovery events per well). The data collected during all events will be evaluated to determine if the recovery system is viable as a long-term system.

Upon completion of the testing above, the data collected will be reviewed and the effectiveness of the system evaluated. Based on the performance of this recovery system, the system may be tested and used to recover LNAPL at AOI-22 Chip Collection Area and AOI-50 Crane Bay.

3 SCHEDULE

Field Event #3 will be undertaken according to the attached field schedule (Figure 13). Unexpected conditions or events may extend the length of time for specific tasks; thus the start dates for subsequent tasks may be delayed. It is also noted that several tasks may require multiple phases of investigation to achieve the task goals. Conversely, certain field tasks may be completed is less time than scheduled; thus subsequent task may be started early.

TABLES

TABLE I
SUMMARY OF FIELD EVENT #3 ACTIVITIES
DELPHI, FLINT-EAST, PLANT 400, DORT HIGHWAY
FLINT, MICHIGAN

Area	Monitoring Well or Sample Designation	Existing or Proposed Location	Zone	Task # Reference	Monthly Monitoring (Task #3)	Stabilization Monitoring	Sample Type	TCL VOCs	TCL SVOCs	TAL Metals	Lead	Total and Hexavalent Chromium
Sitewide Hydro	PZ-4001	Existing	2	-	Yes	-	None	-	-	-	-	-
Sitewide Hydro	PZ-4002	Existing	2	-	Yes	-	None	-	-	-	-	-
Sitewide Hydro	PZ-4119D	Proposed	2	1	Yes	-	Soil Classification	-	-	-	-	-
Sitewide Hydro	PZ-4607D	Proposed	2	1	Yes	-	Soil Classification	-	-	-	-	-
Sitewide Hydro	VHC-4008	Proposed	-	1	NA	-	Soil Classification	-	-	-	-	-
Sitewide Hydro	VHC-4009	Proposed	-	1	NA	-	Soil Classification	-	-	-	-	-
Sitewide Hydro	VHC-4010	Proposed	-	1	NA	-	Soil Classification	-	-	-	-	-
Sitewide Hydro	VHC-4011	Proposed	-	1	NA	-	Soil Classification	-	-	-	-	-
AOI-08	MW-4640S	Existing	1	4	Yes	-	Groundwater	-	-	X	-	X
AOI-08	GP-4201 - GP-42##	Proposed	1	4	NA	-	Groundwater Grab	-	-	-	-	X
AOI-08	MW-4640D	Proposed	2	4	Yes	-	Groundwater	-	-	X	-	X
AOI-08	MW-46##	Proposed	1	4	Yes	-	Groundwater	-	-	X	-	X
AOI-08	MW-46##	Proposed	1	4	Yes	-	Groundwater	-	-	X	-	X
AOI-08	MW-46##	Proposed	1	4	Yes	-	Groundwater	-	-	X	-	X
AOI-08	MW-46##	Proposed	1	4	Yes	Yes	Groundwater	-	-	X	-	X
AOI-11	MW-4003	Existing	1	-	Yes	-	Groundwater	-	X	-	-	-
AOI-11	MW-4004	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-11	MW-4005	Existing	1	-	Yes	Yes	Groundwater	X	X	-	-	-
AOI-11	MW-4008	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-11	MW-4009	Existing	1	5	Yes	-	Groundwater	X	X	-	X	-
AOI-11	MW-4009D	Proposed	2	5	Yes	-	Groundwater	X	X	-	X	-
AOI-11	B-4111*	Proposed	1	5	NA	-	Soil / Groundwater Grab	X	X	-	X	-
AOI-11	MW-4010	Proposed	1	5	Yes	Yes	Groundwater	X	X	-	X	-
AOI-13	MW-4401	Existing	1	14	Yes	-	LNAPL Recovery Test	-	-	-	-	-
AOI-13	MW-4402	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-13	MW-4403	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-13	MW-4404	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-13	MW-4405	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-13	MW-4406	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-13	MW-4407	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-13	MW-4408	Existing	1	14	Yes	-	LNAPL Recovery Test	-	-	-	-	-
AOI-13	MW-4410	Existing	1	14	Yes	-	LNAPL Recovery Test	-	-	-	-	-
AOI-13	MW-4411	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-13	MW-4412	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-13	MW-4413	Existing	1	14	Yes	-	LNAPL Recovery Test	-	-	-	-	-
AOI-13	MW-4415	Existing	1	14	Yes	-	LNAPL Recovery Test	-	-	-	-	-
AOI-13	MW-4416	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-13	MW-4417	Existing	1	-	Yes	Yes	Groundwater	X	X	-	-	-
AOI-13	MW-4418	Existing	1	-	Yes	-	None	-	-	-	-	-

Notes and Abbreviations:
See Page 4

TABLE I
SUMMARY OF FIELD EVENT #3 ACTIVITIES
DELPHI, FLINT-EAST, PLANT 400, DORT HIGHWAY
FLINT, MICHIGAN

Area	Monitoring Well or Sample Designation	Existing or Proposed Location	Zone	Task # Reference	Monthly Monitoring (Task #3)	Stabilization Monitoring	Sample Type	TCL VOCs	TCL SVOCs	TAL Metals	Lead	Hexavalent Chromium
AOI-13	MW-4419	Proposed	1	6	Yes	-	Groundwater	X	X	-	-	-
AOI-13	MW-4420	Proposed	1	6	Yes	-	Groundwater	X	X	-	-	-
AOI-22	MW-4644S	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-22	MW-4645S	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-22	MW-4649S	Proposed	1	7	Yes	-	None	-	-	-	-	-
AOI-22	MW-4650S	Proposed	1	7	Yes	-	None	-	-	-	-	-
AOI-22	MW-4651S	Proposed	1	7	Yes	-	None	-	-	-	-	-
AOI-24	MW-4502	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-24	MW-4503	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-26	B-42612	Proposed	1	8	NA	-	Soil	X	X	-	-	-
AOI-26	MW-4101	Existing	1	PCP	Yes	Yes	Groundwater	X	-	X	-	-
AOI-26	MW-4102	Existing	1	PCP	Yes	Yes	Groundwater	X	-	X	-	-
AOI-26	MW-4103	Existing	1	PCP	Yes	-	Groundwater	X	-	X	-	-
AOI-26	MW-4104	Existing	1	PCP	Yes	-	Groundwater	X	-	X	-	-
AOI-26	MW-4106	Existing	1	PCP	Yes	-	Groundwater	X	-	X	-	-
AOI-26	MW-4107	Existing	2	-	Yes	-	None	-	-	-	-	-
AOI-26	MW-4108	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-26	MW-4109	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-26	MW-4110	Existing	1	PCP	Yes	-	Groundwater	X	-	X	-	-
AOI-26	MW-4111	Existing	1	PCP	Yes	-	Groundwater	X	-	X	-	-
AOI-26	MW-4112	Existing	2	8	Yes	-	Groundwater	X	-	X	-	-
AOI-26	MW-4113	Existing	2	8	Yes	-	Groundwater	X	-	X	-	-
AOI-26	MW-4114	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-26	MW-4115[TBA]	Existing	NA	1	-	-	None	-	-	-	-	-
AOI-26	MW-4115R	Proposed	1	1	Yes	-	None	-	-	-	-	-
AOI-26	MW-4116	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-26	MW-4117	Existing	1	9	Yes	Yes	Groundwater	X	-	-	-	-
AOI-26	MW-4118	Existing	1	9	Yes	-	Groundwater	X	-	-	-	-
AOI-26	MW-4119	Existing	1	9	Yes	-	Groundwater	X	-	-	-	-
AOI-26	MW-4120	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-26	MW-4121	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-26	MW-4122	Existing	1	PCP	Yes	-	Groundwater	X	-	X	-	-
AOI-26	MW-4123	Proposed	1	PCP	Yes	Yes	Soil & Groundwater	X	X	X	-	-
AOI-26	MW-4124	Proposed	1	PCP	Yes	-	Groundwater	X	-	-	-	-
AOI-48	MW-4606	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-48	MW-4607	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-48	MW-4608	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-48	MW-4609	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-48	MW-4612	Existing	2	-	Yes	-	None	-	-	-	-	-

Notes and Abbreviations:
See Page 4

TABLE I
SUMMARY OF FIELD EVENT #3 ACTIVITIES
DELPHI, FLINT-EAST, PLANT 400, DORT HIGHWAY
FLINT, MICHIGAN

Area	Monitoring Well or Sample Designation	Existing or Proposed Location	Zone	Task # Reference	Monthly Monitoring (Task #3)	Stabilization Monitoring	Sample Type	TCL VOCs	TCL SVOCs	TAL Metals	Lead	Hexavalent Chromium
AOI-48	MW-4613[TBA]	Existing	NA	1	NA	-	None	-	-	-	-	-
AOI-48	MW-4613R	Proposed	2	1	Yes	-	None	-	-	-	-	-
AOI-48	MW-4614	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-48	MW-4615	Existing	2	-	Yes	-	None	-	-	-	-	-
AOI-48	MW-4615S	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-48	MW-4606D	Existing	2	-	Yes	-	None	-	-	-	-	-
AOI-48	MW-4608D	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-48 (SE)	GP-4231 – GP-42##	Proposed	1	9	NA	-	Groundwater Grab	X	-	-	-	-
AOI-48 (SE)	MW-4610	Existing	1	9	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (SE)	MW-4610D	Existing	1	9	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (SE)	MW-4610S	Existing	1	9	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (SE)	MW-4642S	Existing	1	9	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (SE)	MW-4643S	Existing	1	9	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (SE)	MW-4118D	Existing	2	-	Yes	-	None	-	-	-	-	-
AOI-48 (SE)	MW-46##	Proposed	1	9	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (SE)	MW-46##	Proposed	1	9	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (SE)	MW-46##	Proposed	1	9	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (SE)	MW-46##D	Proposed	2	9	Yes	Yes	Groundwater	X	-	-	-	-
AOI-48 (NW)	GP-4261 - GP-42##	Proposed	NA	10	NA	-	Soil and NAPL Check	X	-	-	-	-
AOI-48 (NW)	GP-4301 - GP-4306	Proposed	1	10	NA	-	Groundwater Grab	X	-	-	-	-
AOI-48 (NW)	MW-46##	Proposed	1	10	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-46##	Proposed	1	10	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4630M2	Proposed	2	10	Yes	Yes	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4646M	Proposed	2	10	Yes	Yes	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4646D	Proposed	2	10	Yes	Yes	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4647M	Proposed	2	10	Yes	Yes	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4647D	Proposed	2	10	Yes	Yes	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4648	Proposed	2/3	10	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4601	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-48 (NW)	MW-4601D	Existing	2	-	Yes	-	None	-	-	-	-	-
AOI-48 (NW)	MW-4602	Existing	1	-	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4603	Existing	2	-	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4604	Existing	2	-	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4604D	Existing	2	-	Yes	-	Groundwater	X	-	-	-	-
AOI-48 (NW)	RW-4604	Proposed	2	10	-	-	Aquifer Test	-	-	-	-	-
AOI-48 (NW)	MW-4605	Existing	1	-	Yes	-	None	-	-	-	-	-
AOI-48 (NW)	MW-4605D	Existing	2	-	Yes	-	Groundwater	X	-	-	-	-

Notes and Abbreviations:

See Page 4

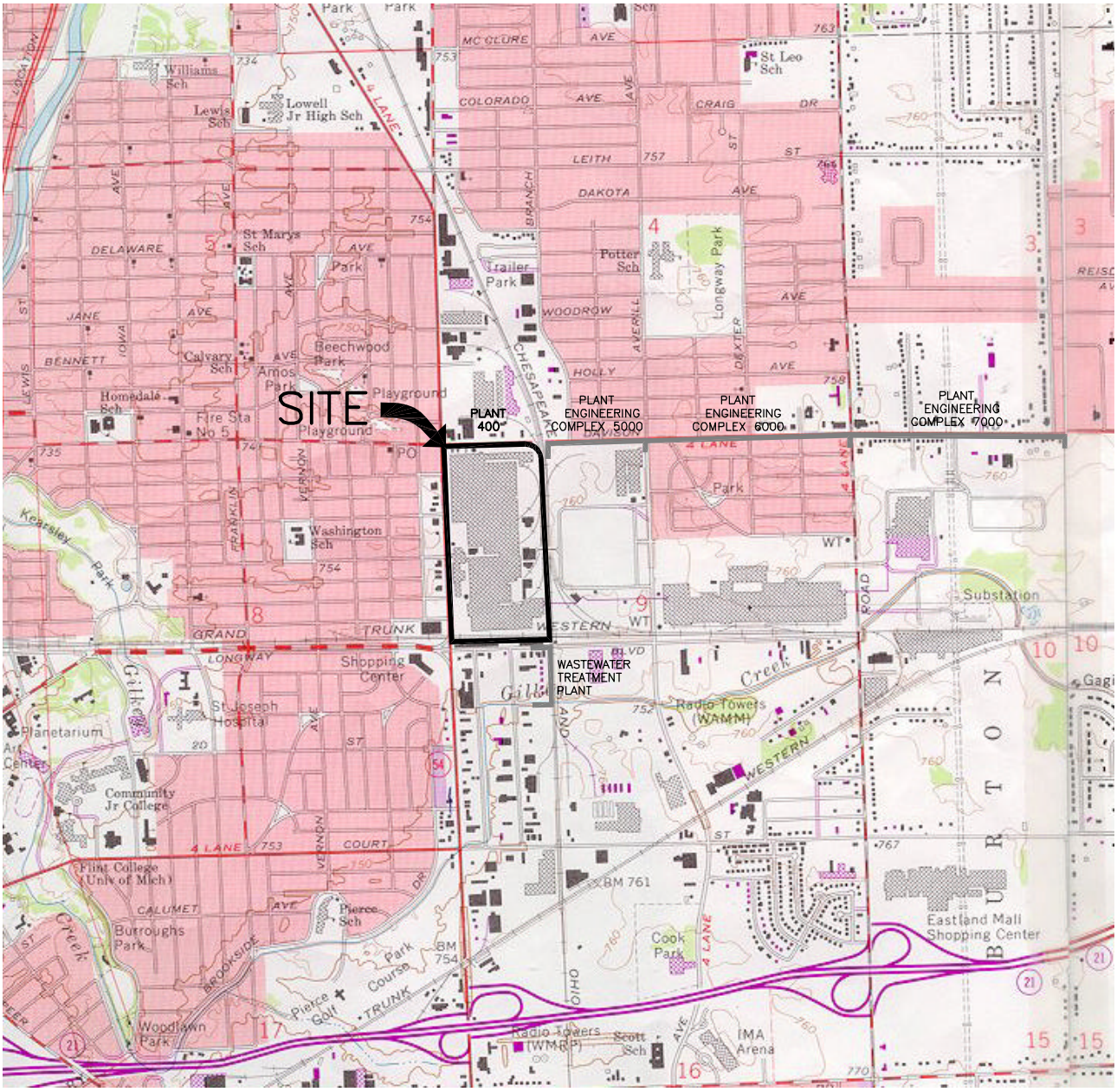
TABLE I
SUMMARY OF FIELD EVENT #3 ACTIVITIES
DELPHI, FLINT-EAST, PLANT 400, DORT HIGHWAY
FLINT, MICHIGAN

Area	Monitoring Well or Sample Designation	Existing or Proposed Location	Zone	Task # Reference	Monthly Monitoring (Task #3)		Sample Type	TCL VOCs	TCL SVOCs	TAL Metals	Lead	Hexavalent Chromium
AOI-48 (NW)	MW-4620D	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4620S	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4623D	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4623S	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4624D	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4624S	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4625D	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4625S	Existing	1	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4626D	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4626S	Existing	1	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4627D	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4627S	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4628D	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4628S	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4629D	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4629S	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4630D	Existing	2	-	Yes	Yes	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4630M	Existing	2	-	Yes	Yes	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4630S	Existing	1	-	Yes		None	-	-	-	-	-
AOI-48 (NW)	MW-4631D	Existing	2	-	Yes	Yes	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4631M	Existing	2	-	Yes	Yes	Groundwater	X	-	-	-	-
AOI-48 (NW)	MW-4631S	Existing	1	-	Yes		None	-	-	-	-	-
AOI-49	MW-4622D	Existing	2	-	Yes		Groundwater	X	-	-	-	-
AOI-49	MW-4622S	Existing	1	-	Yes		Groundwater	X	-	-	-	-
AOI-49	MW-4637S	Existing	1	4	Yes		Groundwater	-	-	X	-	X
AOI-49	MW-4638S	Existing	1	-	Yes	Yes	None	-	-	-	-	-
AOI-49	MW-4639S	Existing	1	-	Yes	Yes	None	-	-	-	-	-
AOI-50	B-4501 - B-4504	Proposed	1	11	NA		Groundwater Grab	X	-	-	-	-
AOI-50	B-4501 - B-4504	Proposed	NA	11	NA		Soil	-	X	-	-	-
AOI-50	MW-46##	Proposed	1	11	Yes		Groundwater	X	-	-	-	-
AOI-50	MW-46##	Proposed	1	11	Yes	Yes	Groundwater	X	-	-	-	-
AOI-50	MW-4621D	Existing	2	-	Yes		None	-	-	-	-	-
AOI-50	MW-4621S	Existing	1	-	Yes		None	-	-	-	-	-
AOI-50	MW-4633S	Existing	1	-	Yes		None	-	-	-	-	-
AOI-50	MW-4634S	Existing	1	-	Yes		Groundwater	X	-	-	-	-
AOI-50	MW-4636S	Existing	1	-	Yes		None	-	-	-	-	-
AOI-50	MW-4635S	Existing	1	-	Yes		None	-	-	-	-	-
AOI-50	MW-4632S	Existing	1	-	Yes		None	-	-	-	-	-

Notes and Abbreviations:

1. * Indicates that location may not be installed. Final well nomenclature will be adjusted as necessary to reflect series order.
2. TBA: To be abandoned.
3. PCP: Identified in the Interim Post Closure Care Plan submitted to the MDEQ on 13 February 2004. Data collected may be used in the RFI.

FIGURES



USGS QUADRANGLE: FLINT NORTH, MICH.

HALEY & ALDRICH

UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

DELPHI ENERGY AND CHASSIS SYSTEMS
PLANT 400 - 1300 NORTH DORT HIGHWAY
FLINT, MICHIGAN

SITE LOCATION MAP

SCALE: 1 IN. = 2,000 FT.

FEBRUARY 2004

FIGURE 1

C:\49017\021 - IM Container Storage Area\Post Closure Care Plan\Figures\Figure_1_Site_Locus.dwg

N

DAVISON ROAD

NORTH MEADE ST.

ILLINOIS AVE.

WISCONSIN AVE.

OHIO AVE.

NORTH DORT HIGHWAY

ELEVATED WALKWAY

ELEVATED WALKWAY

ROBERT T. LONGWAY BLVD.

AOI-11
AOI-13
AOI-14
AOI-16
AOI-17
AOI-18
AOI-21
AOI-22
AOI-23
AOI-25
AOI-26
CONTAINER STORAGE AREA
AOI-27
AOI-31
AOI-35
AOI-37
AOI-45
AOI-49
AOI-50
AOI-3
AOI-4
AOI-8
AOI-9

LEGEND:

- Monitoring Well Screened in Zone 1
- Monitoring Well Screened in Zone 2
- Approximate Location of AOI Boring Location
- Abandoned Monitoring Well
- Approximate Location of Geoprobe Delineation of Samples
- Pre RFI Sample Location
- Piezometer
- Geotechnical Samples - Shelby Tubes
- Hand Augered Locations
- Off-Site Sample Location
- AOI's investigated during RFI.
- Above Grade Structure
- Basements, Trenchs, or Pits
- Approximate extent of underlying clay rich layer beneath Zone 1.

NOTES:

1. Base Plan provided by Delphi Corporation.
2. Locations of Monitoring Wells are based on survey data, other locations are approximate.
3. The first (shallow) saturated zone beneath the facility (depth to groundwater of 4 - 16 ft) is called "Zone 1", except in the northwest corner of the property, where "Zone 1" is absent as shown by extent of clay designation.
4. In the northwest corner of the property, there is only one water-bearing zone identified, and water levels in the area are consistent with "Zone 2" (see below). For risk screening purposes (Appendix C), the upper half of the first saturated zone encountered is identified as "Zone1/Zone2," and the lower half is identified as "Zone 2." These "Zone1/Zone2" monitoring wells are identified as "Zone 2" on this figure.
5. The second (deeper) saturated zone beneath the facility (depth to groundwater of 15 - 25 ft) is called "Zone 2."

0 100 200 300

SCALE IN FEET

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UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

DELPHI CORPORATION
FLINT-EAST, PLANT 400
DORT HIGHWAY
FLINT, MICHIGAN

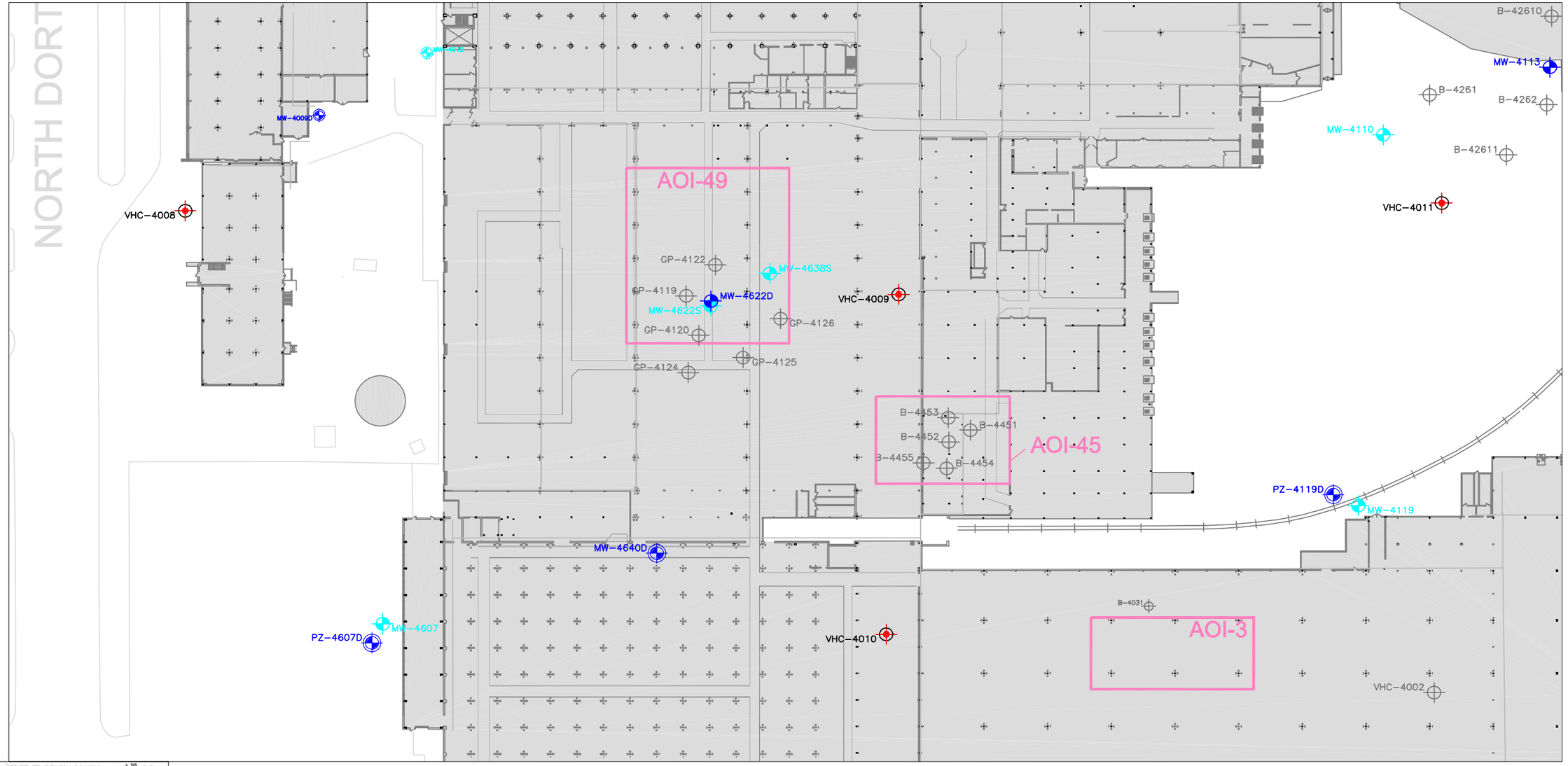
SITE PLAN AND PREVIOUS SAMPLING LOCATIONS

SCALE: AS SHOWN

FEBRUARY 2004

FIGURE 2

G:\49017\027 - FE2 Data Interpretation\Data_Box_FE2\Revised Figure Set - October\October 2003 Sampling Locations.dwg



LEGEND:

- Monitoring Well Screened in First Saturated Zone
- Monitoring Well Screened in Second Saturated Zone
- Approximate Sampling Locations
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 1)
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 2) or Piezometers
- Proposed Field Event #3 Location Field Delineation Groundwater Grab

NOTES:

1. Plan based on plan provided by Delphi Corporation.
2. Proposed Field Event #3 locations are approximate. Locations may be modified based on site features and conditions.

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DELPHI CORPORATION
FLINT-EAST, PLANT 400
DORT HIGHWAY
FLINT, MICHIGAN

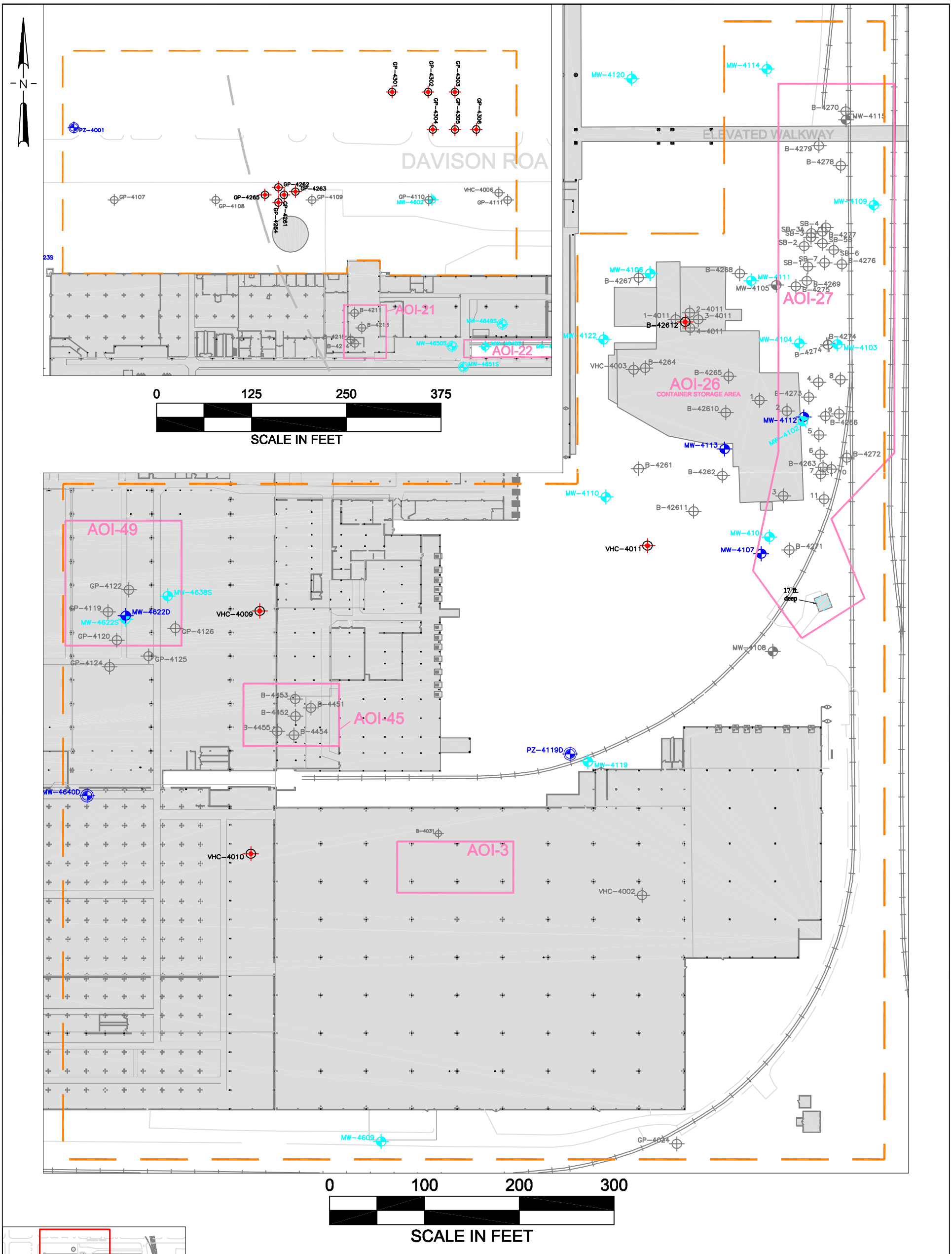
SUPPLEMENTAL SITE-WIDE MONITORING WELL AND BORING LOCATIONS

SCALE: AS SHOWN

FEBRUARY 2004

FIGURE 3

G:\49017\027-FE2 DATA INTERPRETATION\Work Plan Addendum #2\Figures\FE#3_Proposed_locations-1.dwg



LEGEND:

- Monitoring Well Screened in First Saturated Zone
- Monitoring Well Screened in Second Saturated Zone
- Approximate Sampling Locations
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 1)
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 2) or Piezometers
- Proposed Field Event #3 Location Field Delineation Groundwater Grab
- Approximate Area for Underground Sewer Assessment

NOTES:

1. Plan based on plan provided by Delphi Corporation.
2. Proposed Field Event #3 locations are approximate. Locations may be modified based on site features and conditions.

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DELPHI CORPORATION
FLINT–EAST, PLANT 400
DORT HIGHWAY
FLINT, MICHIGAN

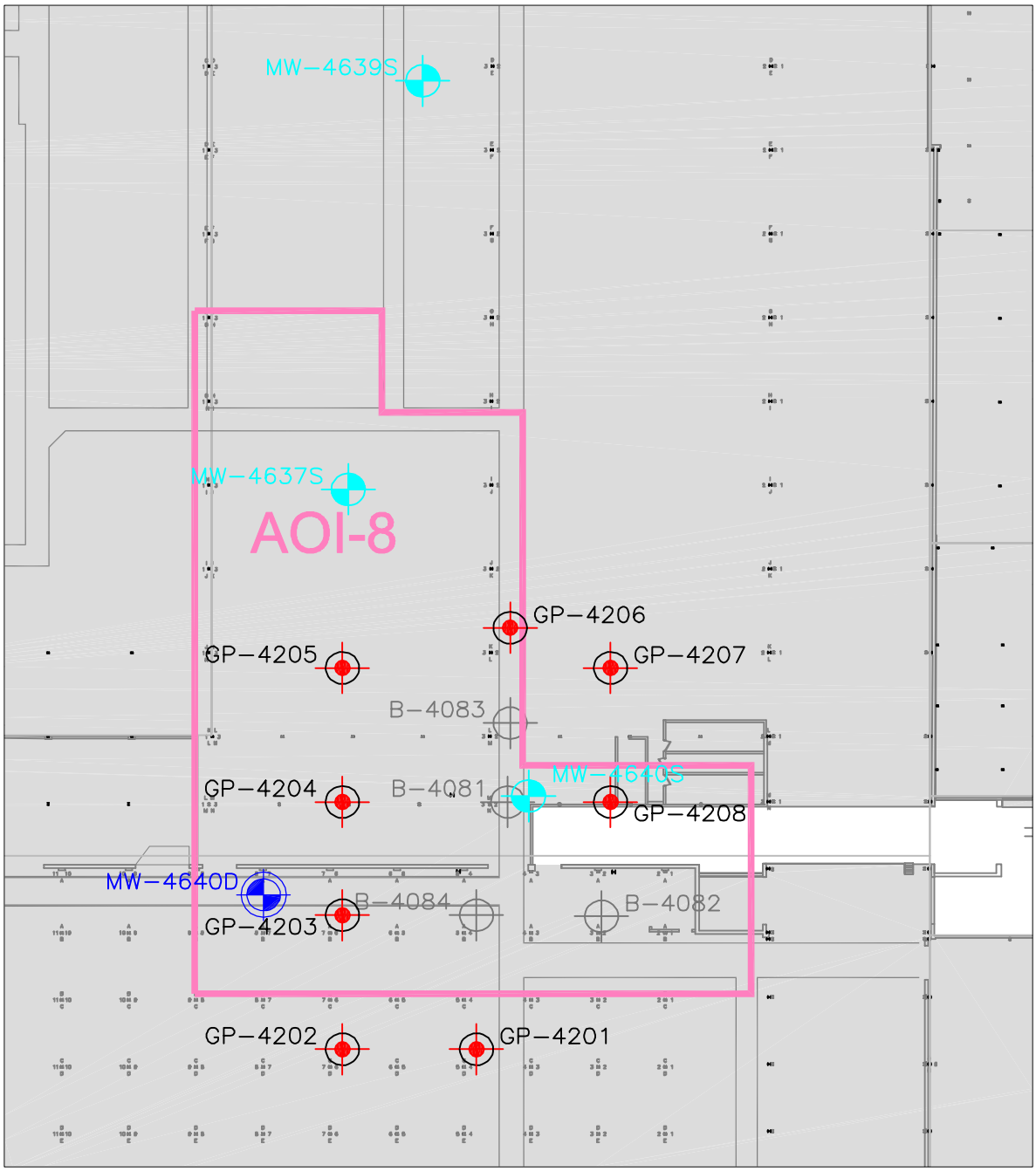
SUBSURFACE UTILITIES ASSESSMENT AREAS

SCALE: AS SHOWN

FEBRUARY 2004

FIGURE 4

G:\49017\027-FE2 DATA INTERPRETATION\Work Plan Addendum #2\Figures\FE#3_Proposed_locations-1.dwg



N

0 50 100 150

SCALE IN FEET

NOTES:
1. Plan based on plan provided by Delphi Corporation.
2. Proposed Field Event #3 locations are approximate. Locations may be modified based on site features and conditions.

LEGEND:
- Monitoring Well Screened in First Saturated Zone
- Approximate Sampling Locations
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 2)
- Proposed Field Event #3 Location Field Delineation Groundwater Grab

DELPHI CORPORATION
FLINT-EAST, PLANT 400
DORT HIGHWAY
FLINT, MICHIGAN

FIELD EVENT #3 - AOI-08 FORMER HARD CHROME PLATING LINE

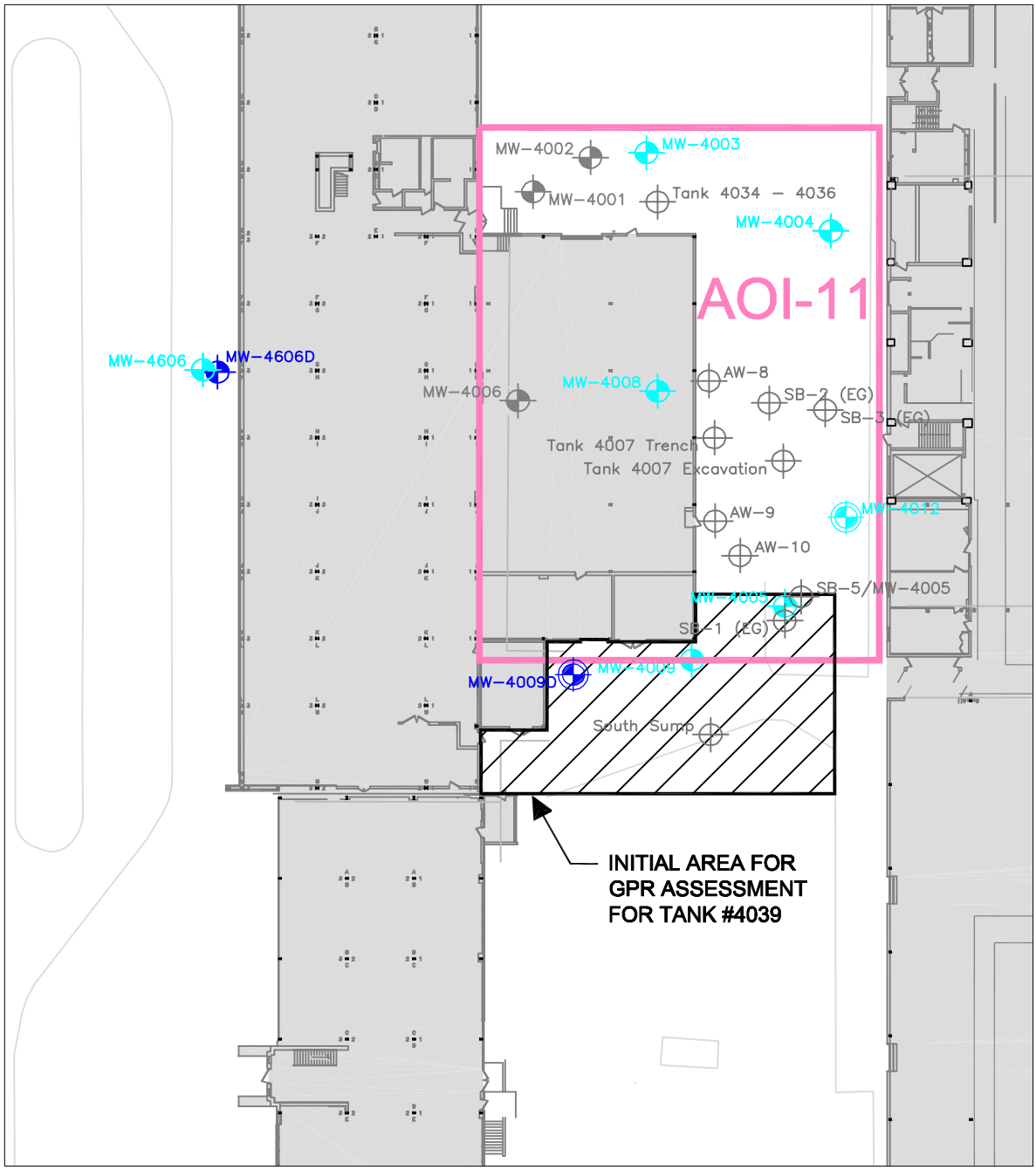
UNDERGROUND ENGINEERING & ENVIRONMENTAL SOLUTIONS

SCALE: AS SHOWN

FEBRUARY 2004

G:\49017\027-FE2 DATA INTERPRETATION\Work Plan Addendum #2\Figures\FE#3_Proposed_locations-1.dwg

FIGURE 5



NOTES:

1. Plan based on plan provided by Delphi Corporation.
2. Proposed Field Event #3 locations are approximate. Locations may be modified based on site features and conditions.

LEGEND:

- Monitoring Well Screened in First Saturated Zone
- Monitoring Well Screened in Second Saturated Zone
- Abandoned Monitoring Well
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 1)
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 2)
- Proposed Field Event #3 Location Field Delineation Groundwater Grab

0 50 100 150

SCALE IN FEET

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DORT HIGHWAY
FLINT, MICHIGAN

FIELD EVENT #3 -
AOI-11 EXECUTIVE GARAGE

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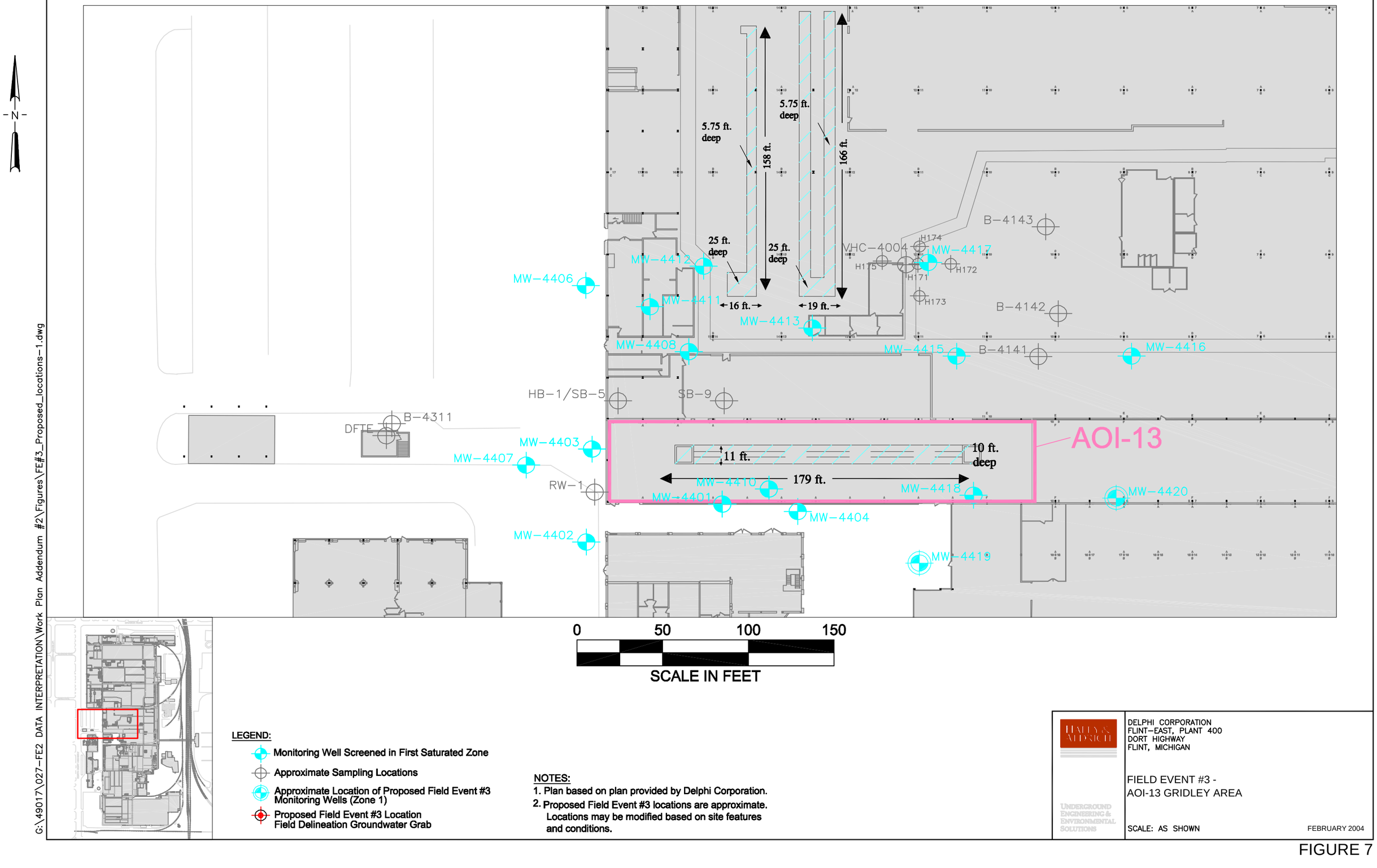
FIGURE 6



LEGEND:

- Monitoring Well Screened in First Saturated Zone
- Approximate Sampling Locations
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 1)
- Proposed Field Event #3 Location Field Delineation Groundwater Grab

NOTES:

1. Plan based on plan provided by Delphi Corporation.
2. Proposed Field Event #3 locations are approximate. Locations may be modified based on site features and conditions.

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FIELD EVENT #3 -
AOI-13 GRIDLEY AREA

SCALE: AS SHOWN

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FIGURE 7

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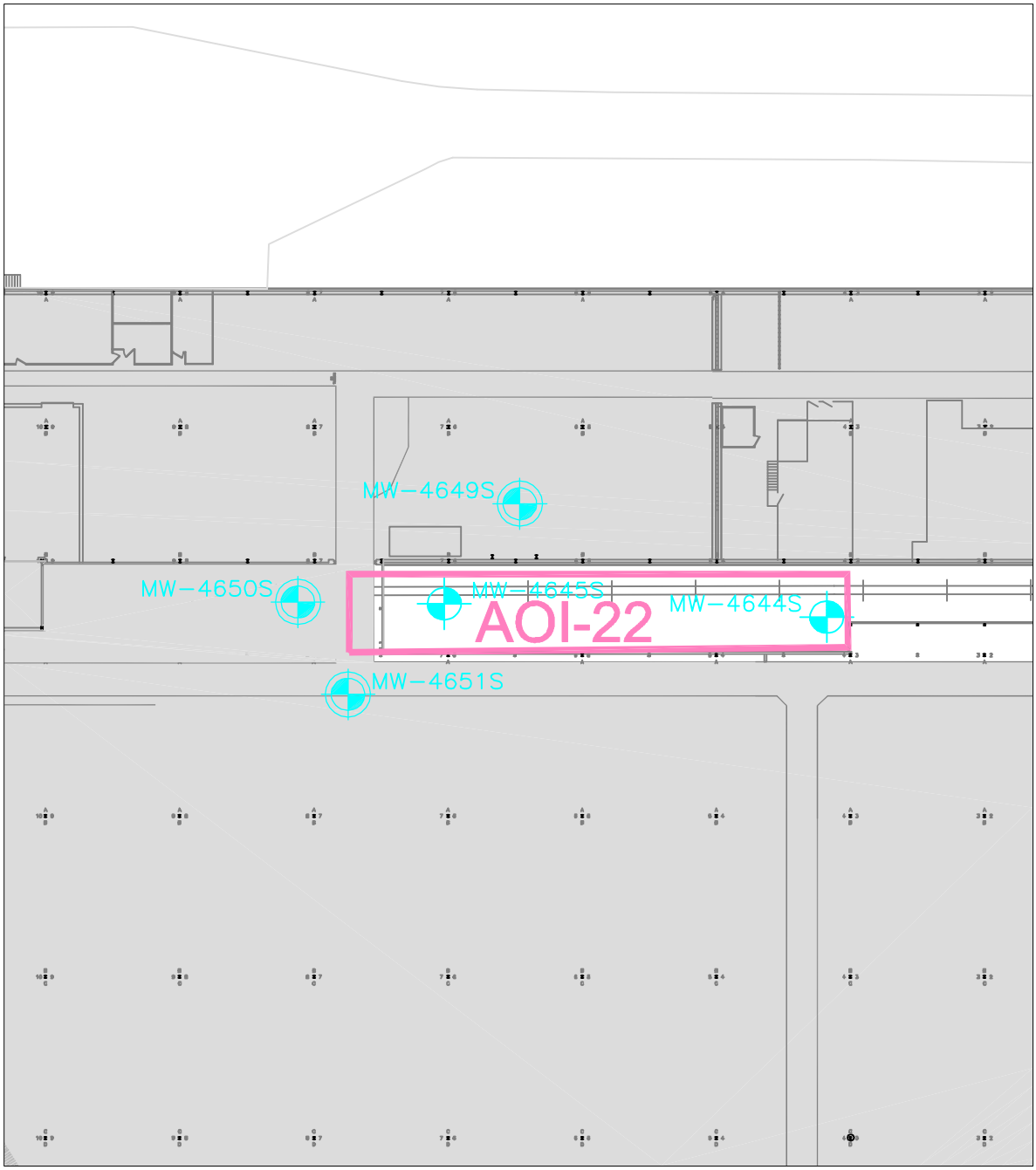

0 50 100 150

SCALE IN FEET

NOTES:
1. Plan based on plan provided by Delphi Corporation.
2. Proposed Field Event #3 locations are approximate. Locations may be modified based on site features and conditions.

LEGEND:
- Monitoring Well Screened in First Saturated Zone
- Approximate Sampling Locations
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 1)
- Proposed Field Event #3 Location Field Delineation Groundwater Grab

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DORT HIGHWAY
FLINT, MICHIGAN

FIELD EVENT #3 -
AOI-22 CHIP COLLECTION AREA

SCALE: AS SHOWN

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FIGURE 8

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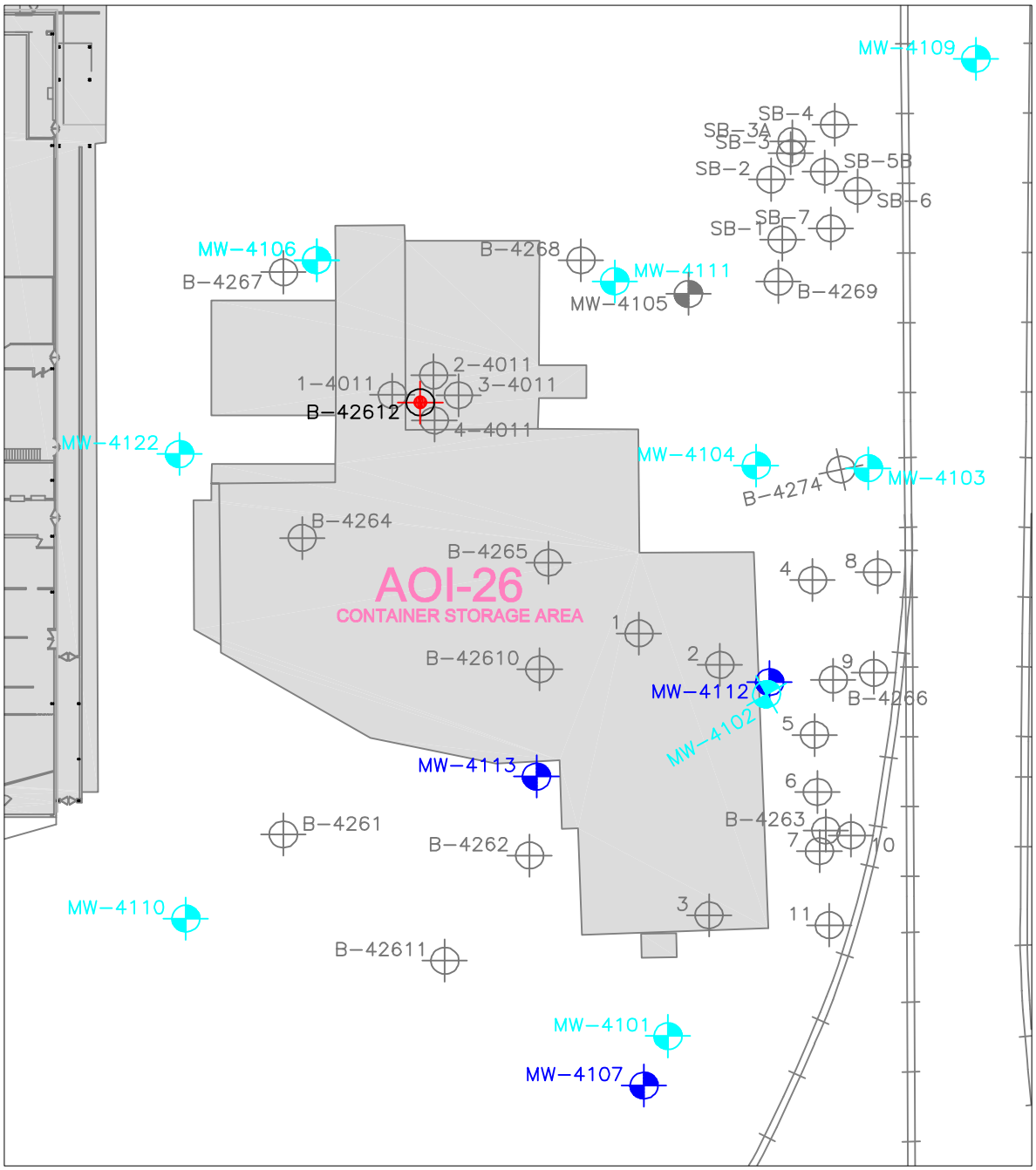

NOTES:

1. Plan based on plan provided by Delphi Corporation.
2. Proposed Field Event #3 locations are approximate. Locations may be modified based on site features and conditions.

LEGEND:

- Monitoring Well Screened in First Saturated Zone
- Monitoring Well Screened in Second Saturated Zone
- Abandoned Monitoring Well
- Approximate Sampling Locations
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 1)
- Proposed Field Event #3 Location Field Delineation Groundwater Grab

0 60 120 180

SCALE IN FEET

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FLINT, MICHIGAN

FIELD EVENT #3 -
AOI-26 CONTAINER STORAGE AREA

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FIGURE 9

N

PZ-4119D
MW-4119
GP-4232
GP-4231
GP-4233
GP-4238
GP-4237
GP-4234
GP-4235
GP-4236
MW-4643S
B-4031
GP-4242
MW-4642S
GP-4241
GP-4240
MW-4117
GP-4239
GP-4243
GP-4244
GP-4245
MW-4118D
GP-4013
B-4484
B-4485
GP-4014
MW-4118
B-4486

0 50 100 150

SCALE IN FEET

LEGEND:

- Monitoring Well Screened in First Saturated Zone
- Monitoring Well Screened in Second Saturated Zone
- Approximate Sampling Locations
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 2) or Piezometers
- Proposed Field Event #3 Location Field Delineation Groundwater Grab

NOTES:

1. Plan based on plan provided by Delphi Corporation.
2. Proposed Field Event #3 locations are approximate. Locations may be modified based on site features and conditions.

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FLINT, MICHIGAN

FIELD EVENT #3 -
AOI-48 SOUTHEAST

SCALE: AS SHOWN

FEBRUARY 2004

FIGURE 10

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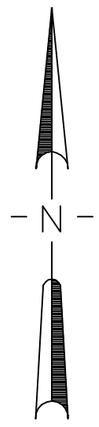
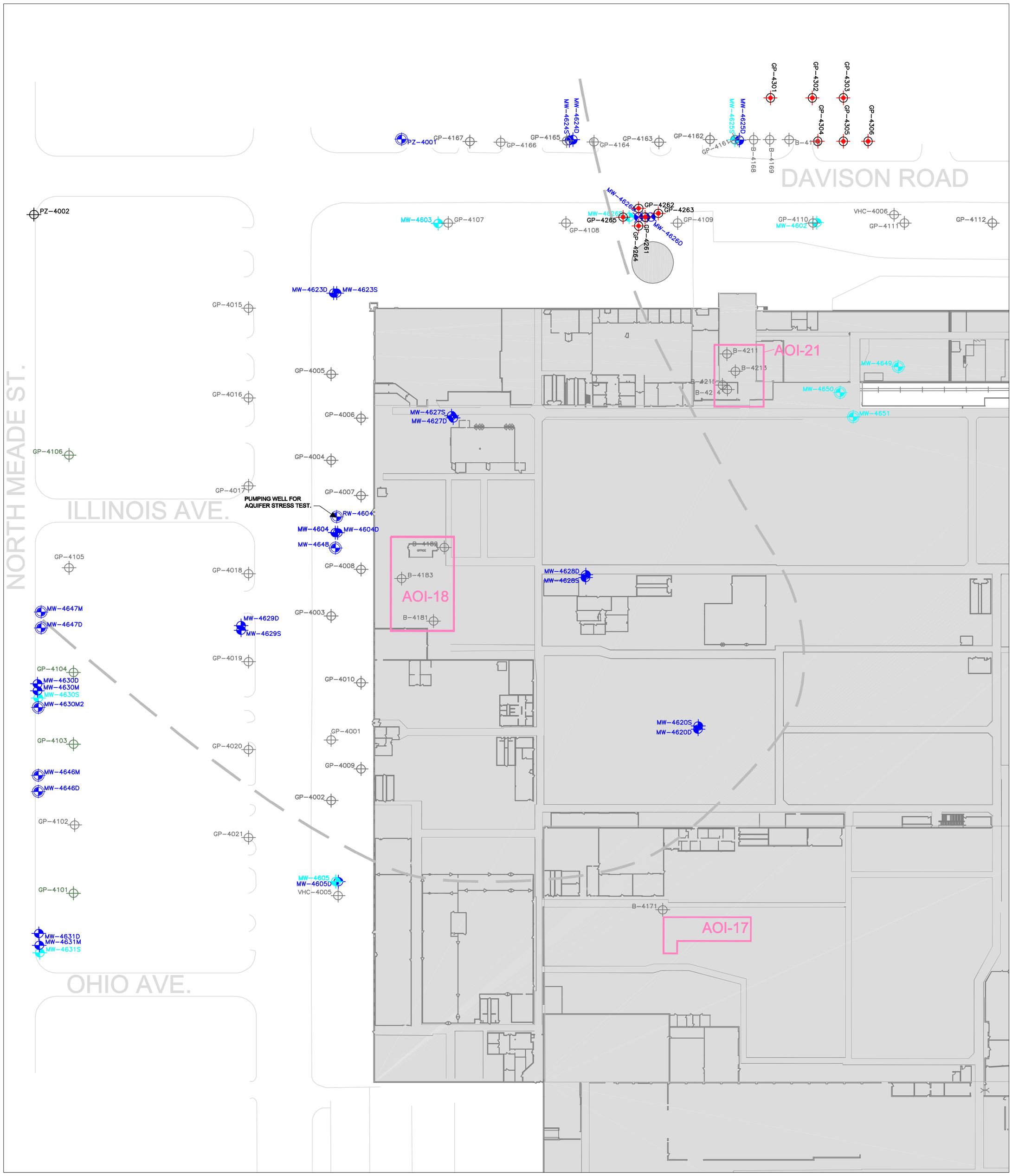
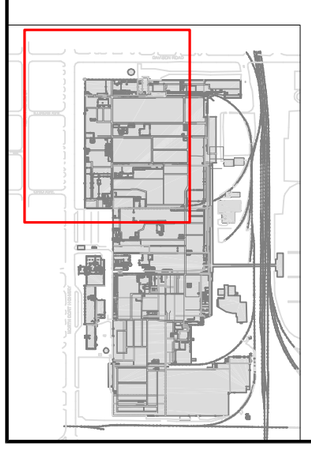




0 80 160 240

SCALE IN FEET



LEGEND:

- Monitoring Well Screened in First Saturated Zone
- Monitoring Well Screened in Second Saturated Zone
- Approximate Sampling Locations
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 1)
- Approximate Location of Proposed Field Event #3 Monitoring Wells (Zone 2) or Piezometers
- Proposed Field Event #3 Location Field Delineation Groundwater Grab

NOTES:

1. Plan based on plan provided by Delphi Corporation.
2. Proposed Field Event #3 locations are approximate. Locations may be modified based on site features and conditions.

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DORT HIGHWAY
FLINT, MICHIGAN

FIELD EVENT #3 -
AOI-48 NORTHWEST

SCALE: AS SHOWN

FEBRUARY 2004

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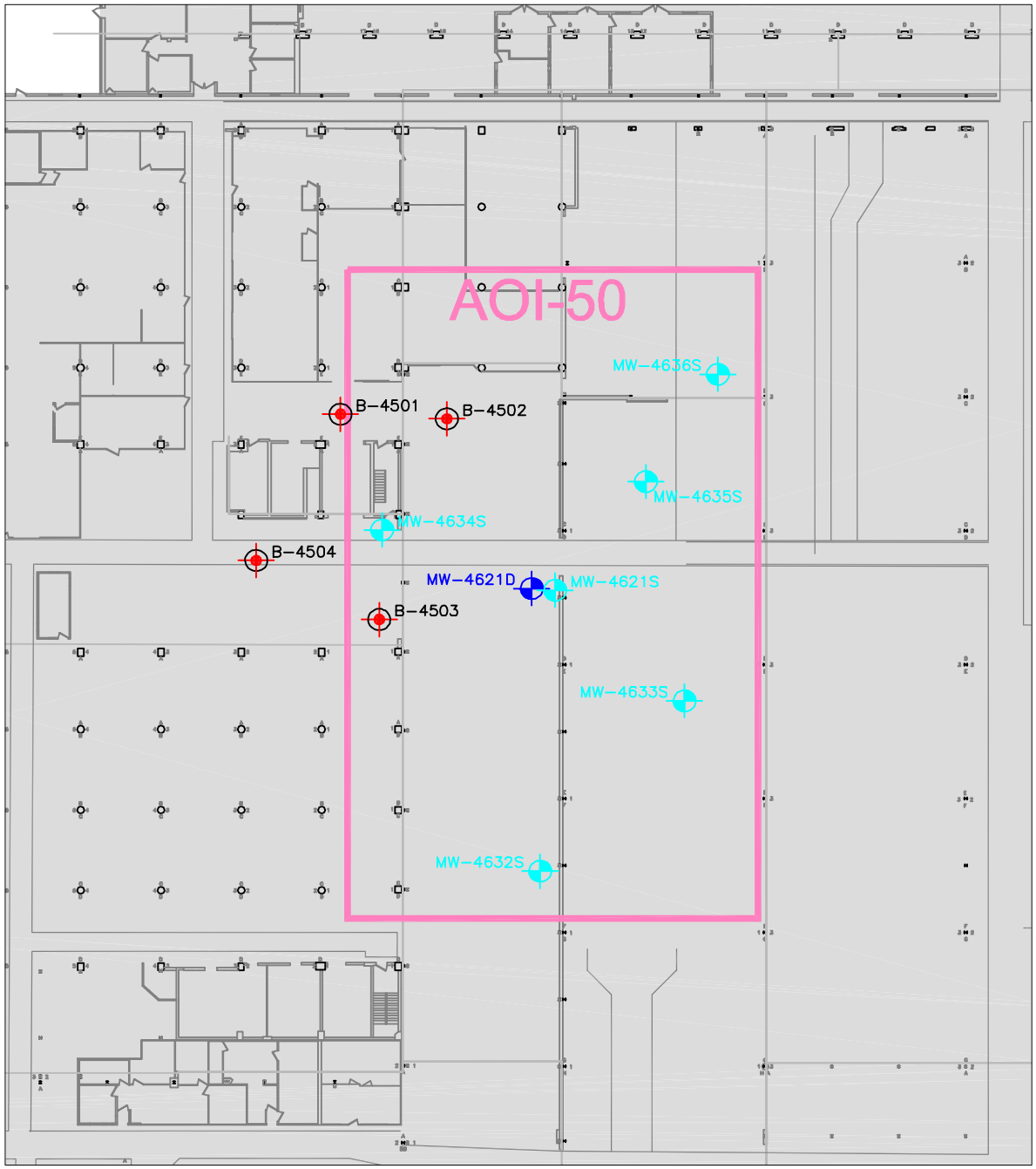
FIGURE 11



0 50 100 150

SCALE IN FEET

NOTES:

1. Plan based on plan provided by Delphi Corporation.
2. Proposed Field Event #3 locations are approximate. Locations may be modified based on site features and conditions.

LEGEND:

- Monitoring Well Screened in First Saturated Zone
- Monitoring Well Screened in Second Saturated Zone
- Proposed Field Event #3 Location
  Field Delineation Groundwater Grab

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DORT HIGHWAY
FLINT, MICHIGAN

FIELD EVENT #3 -
AOI-50 CRANE BAY

SCALE: AS SHOWN

FEBRUARY 2004

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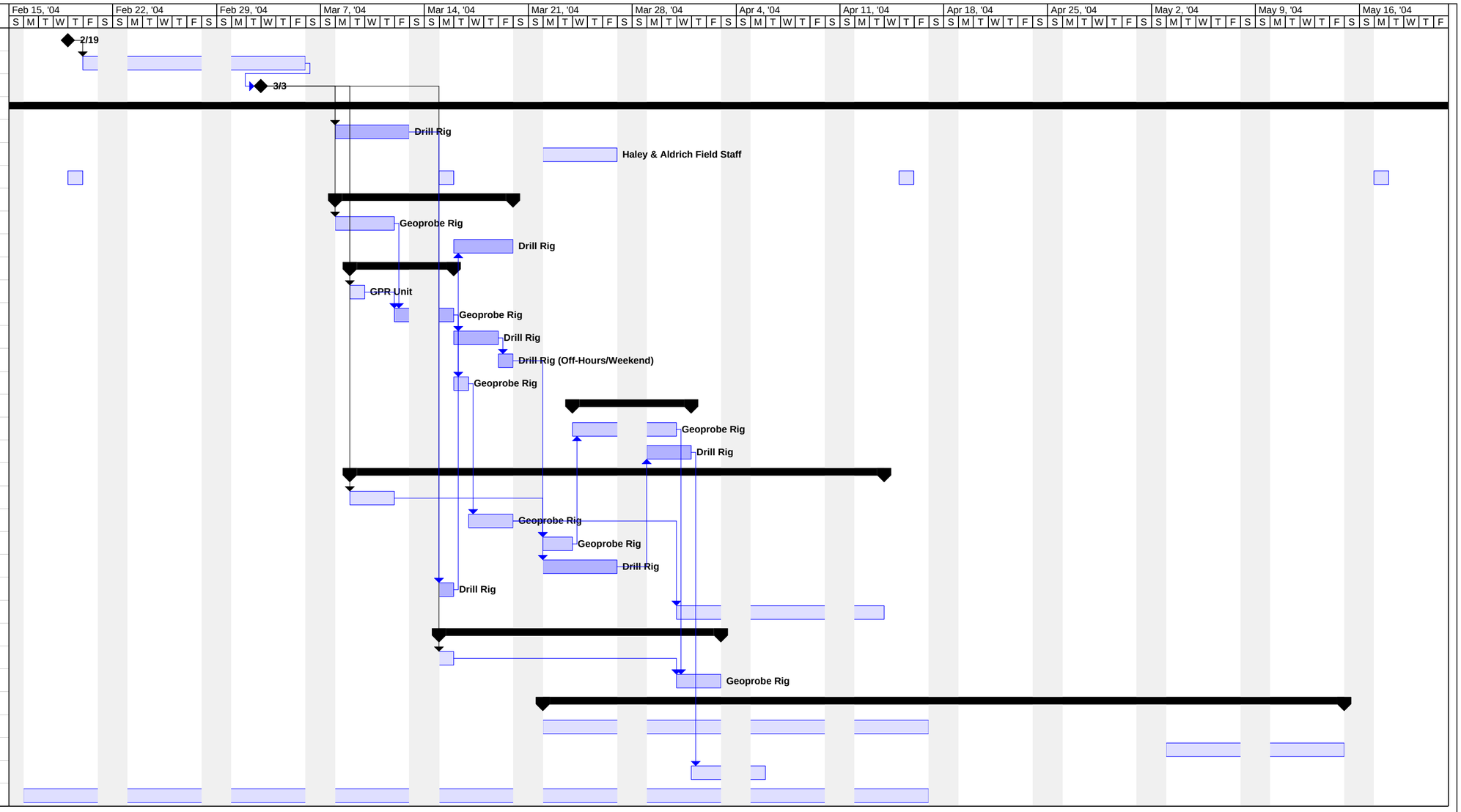
FIGURE 12

ID	Task Name
1	Submittal of Work Plan Addendum #2 to U.S. EPA
2	Mobilization
3	Field Event #3 Meeting
4	**Field Event #3**
5	**Task 1. Supplemental Site-wide MW & Boring Installation**
6	**Task 2. Subsurface Utilities Assessment**
7	**Task 3. Groundwater Elevation Monitoring**
14	**Task 4. AOI-08 Former Hard Chrome Plating Line**
15	Geoprobe Delineation
16	Monitoring Well Installation
17	**Task 5. AOI-11 Executive Garage**
18	GPR Survey
19	Geoprobe Instalation
20	**Task 6. AOI-13 Gridley Area**
21	**Task 7. AOI-22 Chip Collection Area**
22	**Task 8. Container Storage Area**
23	**Task 9. AOI-48 Southeast**
24	Geoprobe Delineation
25	Monitoring Well Installation
26	**Task 10. AOI-48 Northwest**
27	Public Communications
28	Delineation of DNAPL
29	TCE North of Davision Road
30	Supplemental Monitoring and Recovery Wells
31	Recovery Well Installation
32	Aquifer Stress Test
33	**Task 11. AOI-50 Crane Bay**
34	Monitoring Well Sampling
35	Geoprobe/Hand Auger
36	**Task 12. Sitewide Groundwater Sampling**
37	Inclusive Site-Wide
38	Stabilization Sampling
39	**Task 13. Surveying**
40	**Task 14. Free Product Recovery Assessment at AOI-13**



Project: FE3_Schedule
Date: Tue 2/17/04

Task | Progress | Summary | Rolled Up Split | Rolled Up Progress | Project Summary
Split | Milestone | Rolled Up Task | Rolled Up Milestone | External Tasks

Haley & Aldrich, Inc.
February 2004

DELPHI CORPORATION, FLINT-EAST, PLANT 400, DORT HIGHWAY
FIELD EVENT #3 FIELD SCHEDULE
FIGURE 13

APPENDIX A

FIELD SAMPLING PROCEDURE

2.5 SOIL CLASSIFICATION

INTRODUCTION

The stratigraphic log is a factual description of the soil at the borehole location and is relied upon to interpret the soil characteristics, and their influence and significance in the subsurface environment. The accuracy of the stratigraphic log is to be verified by the person responsible for interpreting subsurface conditions. An accurate description of the soil stratigraphy is essential for a reasonable understanding of the subsurface conditions. Confirmation of the field description by examination of representative soil samples by the project geologist, hydrogeologist, or geotechnical engineer (whenever practicable) is recommended.

The ability to describe and classify soil correctly is a skill that is learned from a person with experience and by systematic training and comparison of laboratory results to field descriptions.

PROCEDURES REFERENCED

- 2.2 Soil Borings

DESCRIPTIONS

Several methods for classifying and describing soils or unconsolidated sediments are in relatively widespread use. The Unified Soil Classification System (USCS) is the most common. With the USCS, a soil is first classified according to whether it is predominantly coarse-grained or fine-grained.

The description of fill soil is similar to that of natural undisturbed soil except that it is identified as fill and not classified by USCS group, relative density, or consistency. Those logging soils must attempt to distinguish between soils that have been placed (i.e., fill) and not naturally present; or soils that have been naturally present but disturbed (i.e., disturbed native).

It is necessary to identify and group soil samples consistently to determine the subsurface pattern or changes and non-conformities in soil stratigraphy in the field at the time of drilling. The stratigraphy in each borehole during drilling is to be compared to the stratigraphy found at the previously completed boreholes to ensure that pattern or changes in soil stratigraphy are noted and that consistent terminology is used.

Visual examination, physical observations and manual tests (adapted from ASTM D2488, visual-manual procedures) are used to classify and group soil samples in the field and are summarized in this subsection. ASTM D2488 should be reviewed for detailed explanations of the procedures. Visual-manual procedures used for soil identification and classification include:

- visual determination of grain size, soil gradation, and percentage fines;
- dry strength, dilatancy, toughness, and plasticity (thread or ribbon test) tests for identification of inorganic fine grained soil (e.g., CL, CH, ML, or MH); and
- soil compressive strength and consistency estimates based on thumb indent and pocket penetrometer (preferred) methods.

The three main soil divisions are: coarse grained soil (e.g., sand and gravel), fine grained soil (e.g., silt and clay), and soil with high natural organic matter content (e.g., peat and marl).

Coarse Grained Soil

The USCS group symbols for coarse-grained soils are primarily based on grain or particle size, grain size distribution (gradation), and percent fines (silt and clay content).

Coarse-grained soils are then further subdivided according to the predominance of sand and gravel. Course grained soil is made up of more than 50 percent, by weight, sand size, or larger (75 μm diameter, No. 200 sieve size or larger). It is noted that there are other definitions for coarse grained or coarse textured soil and for sand size such as soil having greater than 70 percent particles equal to or greater than 50 μm diameter.

Descriptions for grain size distribution of soil include; poorly graded (i.e., soil having a uniform grain size, SP and GP) and well graded (i.e., poorly sorted; having wide range of particle sizes with substantial intermediate sizes, SW and GW).

Coarse-grained soils are further classified based on the percentage of silt and clay it contains (fines content). Coarse-grained soils containing greater than 12 percent fines are commonly described as dirty. This description arises from the soil particles that adhere when the soil is rubbed between the hands or adhere to the sides of the jar after shaking or rolling the soil in the jar. The jar shake test, which results in segregation of the sand and gravel particles, is also used as a visual aid in determining gravel and sand percentages.

Examples of the group symbol, name, and adjectives used to describe the primary, secondary, and minor components of soil are; GW - Sandy Gravel (e.g., 70 percent gravel and 30 percent sand) or Sandy Gravel trace silt (less than 10 percent silt), and SP - Sand, uniform.

Relative density is an important parameter in establishing the engineering properties and behavior of coarse-grained soil. Relative density of non-cohesive (granular) soil is

determined from standard penetration test (SPT) blow counts (N values) (after ASTM Method D1586).

The SPT gives a reliable indication of relative density in sand and fine gravel. N values in coarse-grained soil are influenced by a number of factors that can result in overestimates of relative density (e.g., in coarse gravel and dilatent silty fine sand) and can be conservative and underestimate the relative density (e.g., sand below the groundwater table and uniform coarse sand). These effects will be assessed by the project manager, if required, and need not be taken into account by field personnel.

Other dynamic methods, such as modified SPT and cone penetration tests, are used on occasion to supplement or replace the SPT method for certain site-specific conditions. The details of all modifications to the SPT or substitute methods should be recorded as they are required to interpret test results and correlate to relative density.

Fine Grained Soil

A soil is fine grained if it is made up of half or more of clay and silt (i.e., fines greater than 50 percent by weight passing the 75 μm (No. 200) sieve size). A description of visual-manual field methods and criteria (after ASTM D2488) that are used to further characterize and group fine grained soil (e.g., CL, CH, ML, or MH) including dry strength, dilatancy, toughness, and plasticity (thread or ribbon test) follows. Fine-grained soils are subdivided on a basis of the liquid limit and the degree of plasticity.

The accurate identification of silts and clays can be aided by the use of some single field tests. Clay is sticky, will smear readily, and can be rolled into a thin thread even when the moisture content is low. When it is dry, clay forms hard lumps. Silt on the other hand, has a low dry strength, can be rolled into threads only at high moisture content, and a wet silt sample will puddle when it is tapped.

CRITERIA FOR DESCRIBING DRY STRENGTH

Description	***Criteria***
None	The dry specimen crumbles into powder with mere pressure of handling.
Low	The dry specimen crumbles into powder with some finger pressure.
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure.
High	The dry specimen crumbles into powder with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very High	The dry specimen cannot be broken between the thumb and a hard surface.

CRITERIA FOR DESCRIBING DILATANCY

Description	*Criteria*
None	No visible change in small wetted specimen when rapidly shaken in palm of hand.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing or stretching.

CRITERIA FOR DESCRIBING TOUGHNESS

Description	*Criteria*
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness.
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.

CRITERIA FOR DESCRIBING PLASTICITY

Description	*Criteria*
Nonplastic	A 1/8-inch (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be re-rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

Examples of group symbol identification based on visual-manual procedures and criteria for describing fine grained soil are:

Group Symbol	***Dry Strength Plasticity***	***Dilatancy***	***Toughness***
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Slight Medium to high	None to slow	Medium
MH	Low Low to medium	None to slow	Low to medium Low
CH	High to very high	None	High High

A requirement for positive classification by USCS group symbols (as described in Test Method ASTM D2487) is laboratory determination of particle size characteristics, liquid limit and plasticity index. The need for this type of testing will be determined by the project geologist, hydrogeologist, or geotechnical engineer.

Examples of name terminology that accompanies the group symbols are ML - Sandy Silt (e.g., 30 percent sand) and CL - Lean Clay with sand (e.g., 15 to 29 percent sand).

The correlation between N value and consistency for clays is rather unreliable. It is preferable to determine consistency using more appropriate static test methods, particularly for very soft to stiff clay soil. N value estimates of consistency are more reasonable for hard clay.

Unconfined compressive strength (Su) may be estimated in the field from the pocket penetrometer test method. To obtain a pocket penetrometer estimate of consistency and compressive strength, the soil core is cut perpendicular to the core length, the length of core (minimum 4 inches) is held in the hand and a moderate confining pressure is applied to the core (not sufficient to deform the core); the penetrometer piston tip is slowly inserted into the perpendicular face of the core until the penetrometer indents into the soil core to the mark indicated on the tip of the penetrometer piston; the penetrometer estimate of soil compressive strength (Su) is the direct reading of the value mark on the graduated shaft (in tons per square foot or other unit of pressure as indicated) indicated by the shaft ring marker, or in some models, by the graduated piston reading at the shaft body. To obtain an average estimate, this procedure is completed several times on both ends and mid cross-section of the core. For Shelby Tube (or thin wall sampler) samples the pocket penetrometer tip is applied to the exposed bottom of the sample at several locations.

Estimates of compressive strength for clay soil of very soft to stiff consistency are better established by in situ shear vane tests or other static test methods.

The description of consistency (or strength) is an important element in determining the engineering properties and strength characteristics of fine-grained cohesive soil. Consistency terms (e.g., soft, hard) are based on the unconfined compressive strength (Su) and shear strength or cohesion (cu) of the soil.

The ease and pattern of soil vapor and groundwater movement in the subsurface is influenced by the natural structure of the soil. Soil structure, for the most part, depends on the deposition method and, to a lesser extent, climate.

Visual Appearance/Other Features

Those logging soils should also note the presence, depth and components of fill soils (if evident), and note the distinction between disturbed native soils (i.e., excavation likely performed) vs. undisturbed native soils.

Other features such as root presence/structure, and soil fractures should also be recorded. Soil fractures should be described noting fracture orientation (i.e., horizontal/vertical), length/aperture and appearance of soil infilling, oxidation and/or weathering (if present).

FIELD SCREENING

Field Sample Screening

Upon the collection of soil samples, the soil is screened with a photoionization detector (PID) for the presence of organic vapor. This is accomplished by running the PID across the soil sample. The highest reading and sustained readings are recorded.

Note: The PID measurement must be done upwind of the excavating equipment or any running engines so that exhaust fumes will not affect the measurements.

Another method of field screening is head space measurements. This consists of placing a portion of the soil sample in a sealable glass jar, placing aluminum foil over the jar top, and tightening the lid. Alternatively, plastic sealable bags maybe utilized for field screen in lieu of glass containers. The jar should only be partially filled. Shake the jar and set aside for at least 30 minutes. After the sample has equilibrated, the lid of the jar can be opened; the foil is punctured with the PID probe and the air (headspace) above the soil sample is monitored. This headspace reading on the field form or in the field book is recorded.

Note: Perform all headspace readings in an area that is not subject to wind. Also, in the winter, it is necessary to allow the samples to equilibrate in a warm area (e.g., site trailer, van, etc.). This requirement is dictated by the Work Plan.

All head space measurements must be completed under similar conditions to allow comparability of results.

NAPL DETECTION

During soil examination and logging, the sampler shall carefully check for the presence of light or dense NAPL. NAPL may be present in gross amounts or present in small/minute quantities. The adjectives and corresponding quantities used when describing NAPL within a soil matrix are as follows:

Visual Description	***Fraction of Soil Pore Volume Containing NAPL***
Saturated	>0.5
Some	0.5 - 0.25
Trace	<0.25

A complete description of NAPL, must describe the following:

- color;
- quantity;
- density (compared to water i.e., light/floats or heavy/sinks);
- odor (if observed); and
- viscosity (i.e., mobile/flowable, non-mobile/highly viscous-tar like).

The presence of an "iridescent sheen" by itself does not constitute 'NAPL presence', but may be an indicator that NAPL is close to the area.

NAPL presence within a soil matrix may be confirmed by placing a small soil sample within water, shaking, and observing for NAPL separation (i.e., light or dense), from the soil matrix.

Trace amounts of NAPL are identified/confirmed by a close visual examination of the soil matrix, [i.e., separate soil by hand (wearing disposable gloves)] and careful inspection of the soil separation planes/soil grains is performed for NAPL presence.

Often during the sample examination with a knife, an iridescent sheen will be noted on the soil surface (i.e., clay/silts) if the knife has passed through an area of NAPL.

There are a number of more sophisticated tests available to confirm/identify NAPL presence, these are:

- UV fluorescent analysis;
- Sudan IV dye shake test;
- hydrophobic dyes;
- centrifugation; and
- chemical analysis.

For UV fluorescence, soil samples are placed in a Ziploc bag, which are marked with the boring location and depth. The samples are then taken to a dark room where they are placed under a UV light. Samples with DNAPL present in them will fluoresce a milky-white color.

Sudan IV dye shake tests are performed by combining a small amount of soil sample, water and Sudan IV together in a vial with a cap. The Sudan IV is fat-soluble, thus, the dye will be released to the water in the presence of DNAPL. After combining the soil, water and dye, cap the vial and shake vigorously. If DNAPL is present, the water will become a pinkish-red hue.

The Sudan IV dye shake test is dependent upon the nature of the soil that is being tested. Clayey soils have a tendency to cloud the water and obscure the dye release. If clayey soils are the target zone, a combination of visual observation, field and headspace screening, UV fluorescence and Sudan IV dye shake tests should be performed to determine whether DNAPL is present in the soil.

Typically consultants will utilize organic vapor detection results, visual examination, soil/water shake testing, and chemical analysis, to confirm NAPL presence. The more complex techniques described may be incorporated on sites where clear colorless NAPL is present and its field identification is critical to the program.

Note: When describing the presence of vegetative matter in the soil sample, do not use the term "organic" as this often leads to confusion with regards to the presence of organic chemicals (i.e., NAPL).

EQUIPMENT/MATERIALS

- Pocket knife or small spatula
- Small handheld lens
- Stratigraphic Log (Overburden) (Form 2.6-01)
- Tape Measure

- Sudan IV dye
- Vial
- Ziplock bags

REFERENCES

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2. ASTM Standards on Environmental Sampling (1995), Standard D 2488-93, "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)"
3. ASTM Standards on Environmental Sampling (1995), Standard D 4700-91, " Guide for Soil Sampling from the Vadose Zone".
4. ASTM Standards on Environmental Sampling (1995), Standard D 1586-92, " Test Method for Penetration Test and Split-Barrel Sampling of Soils".
5. ASTM Standard D 2487, " Classification of Soils for Engineering Purposes (Unified Soil Classification System)".
6. Geotechnical Gauge, Manufactured by W.F. McCollough, Beltsville, MD.
7. Sand Grading Chart, by Geological Specialty Company, Northport, Alabama.